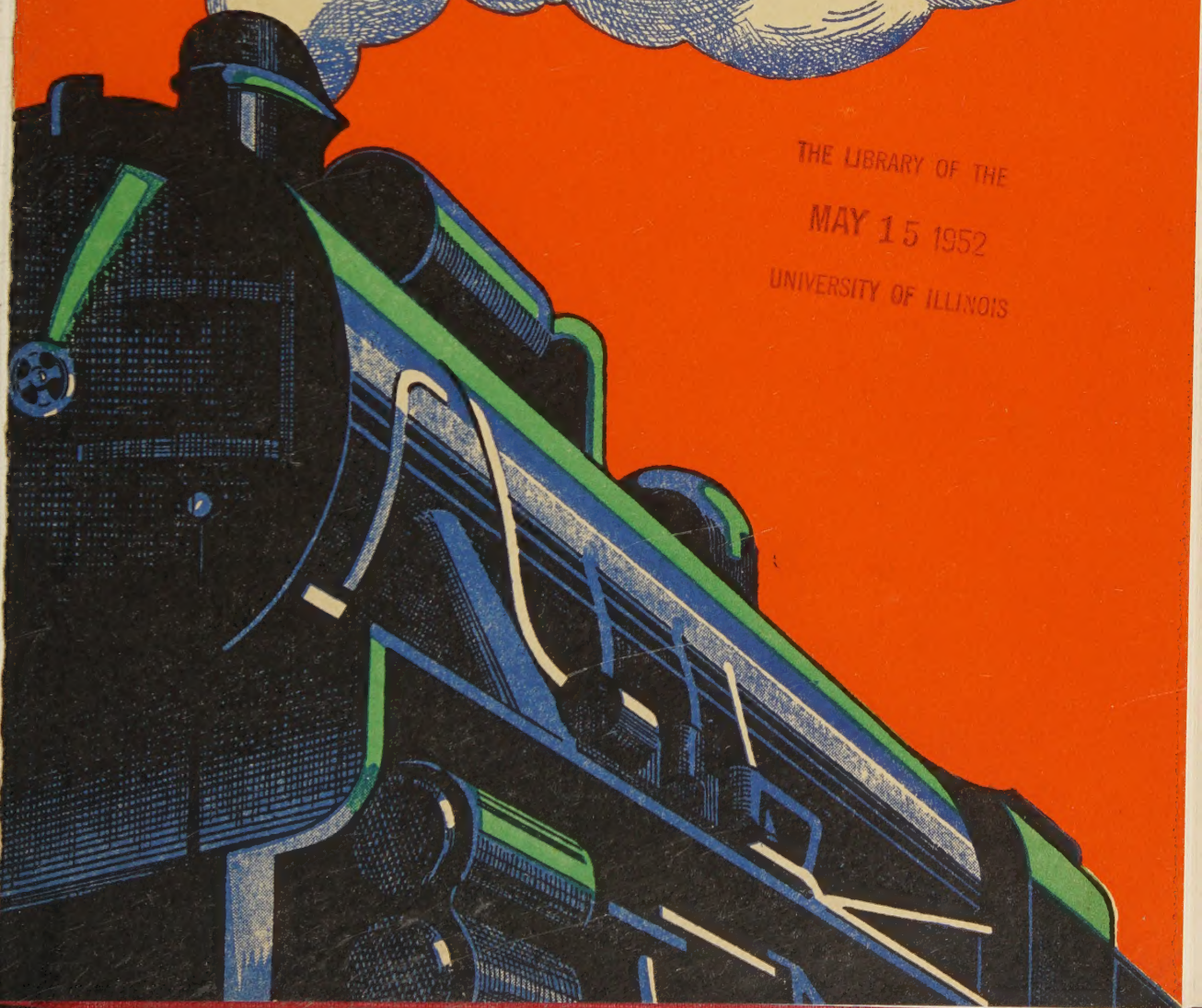
VOL. XXIX. — No. 4. APRIL 1952.

Monthly Bulletin of the International Railway Congress Association

(English Edition)



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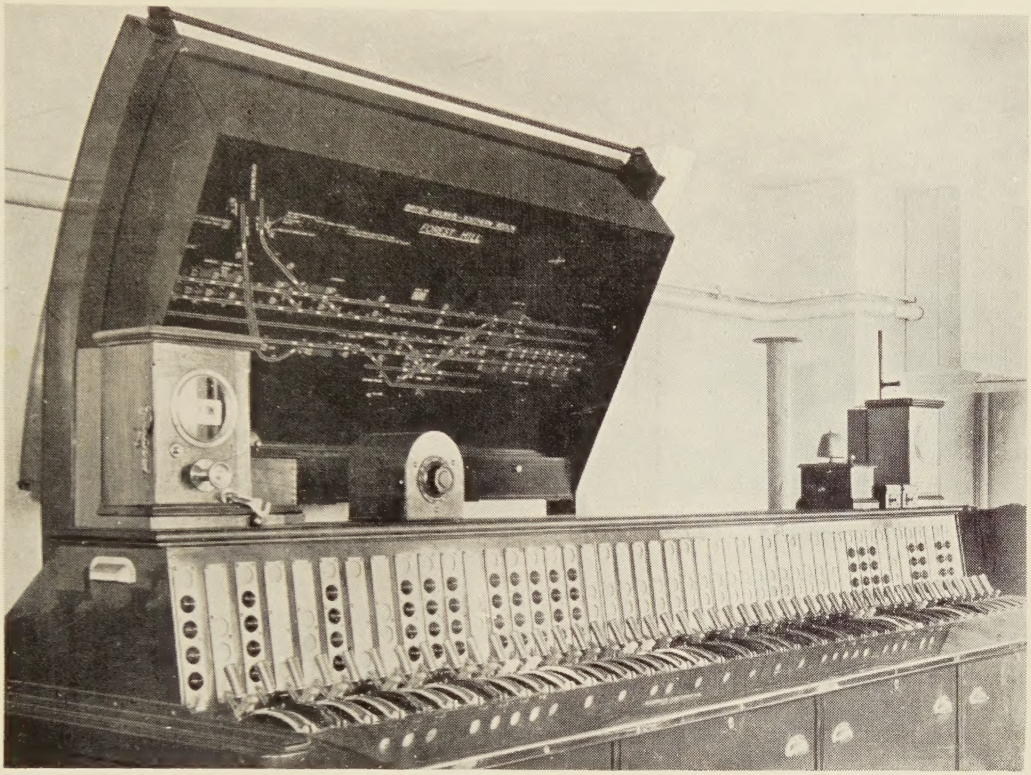

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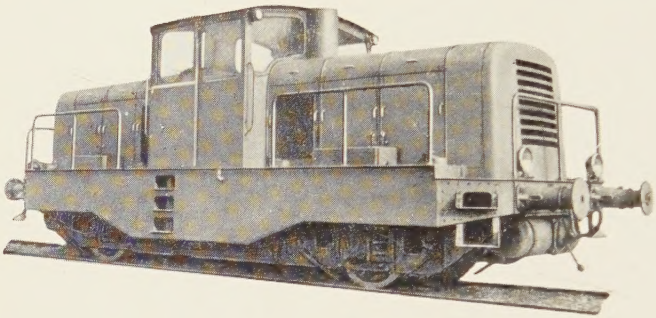

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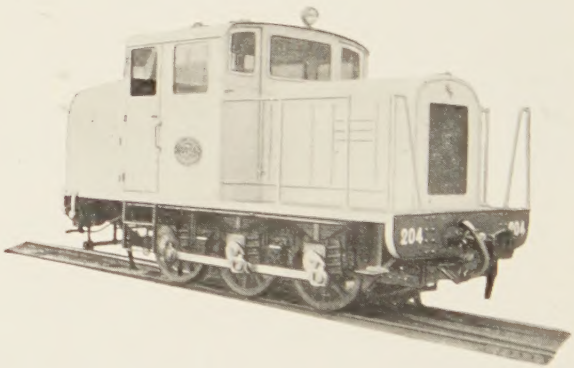

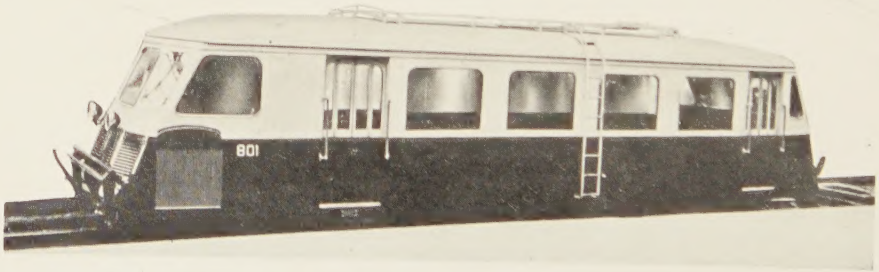

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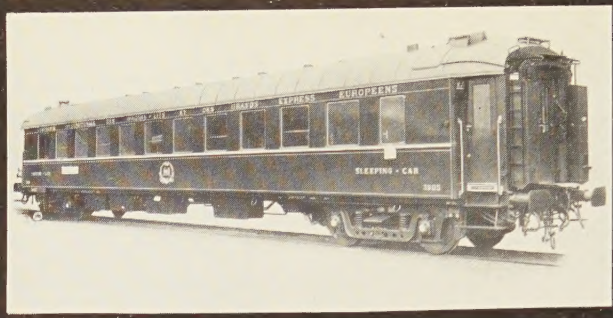

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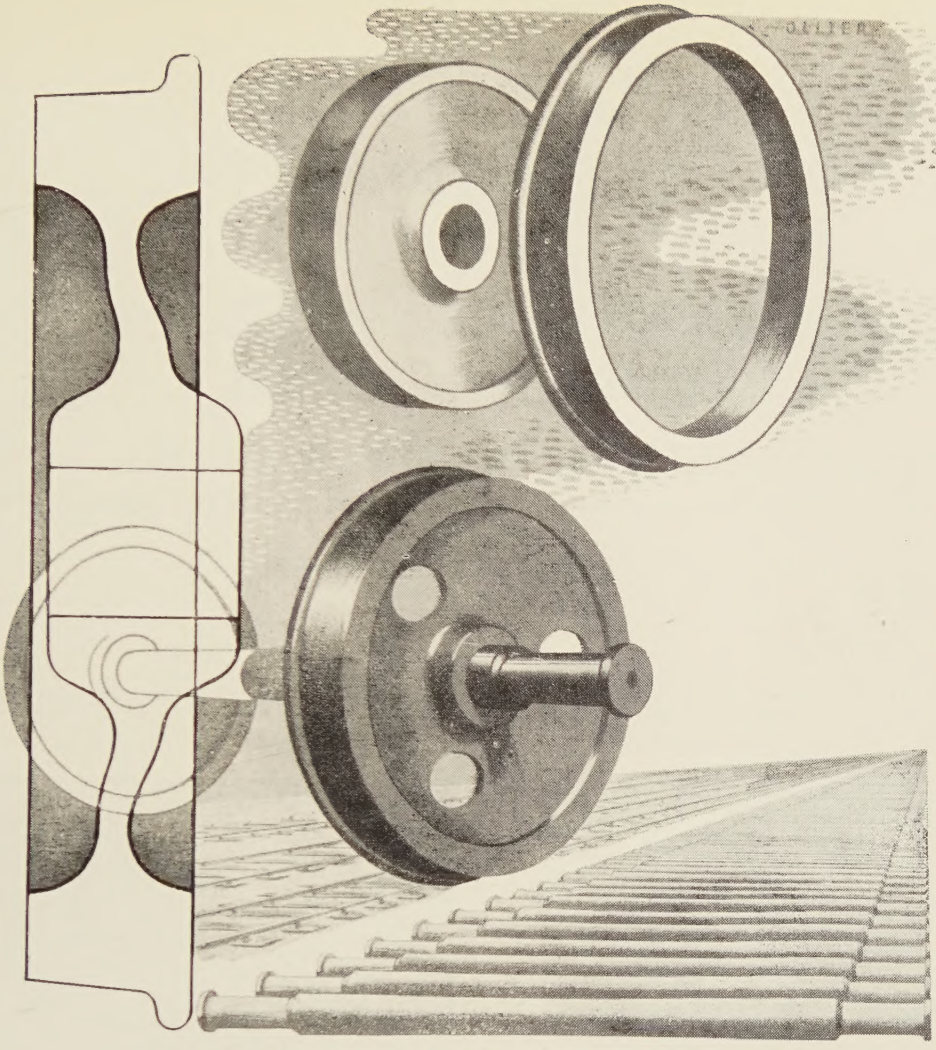

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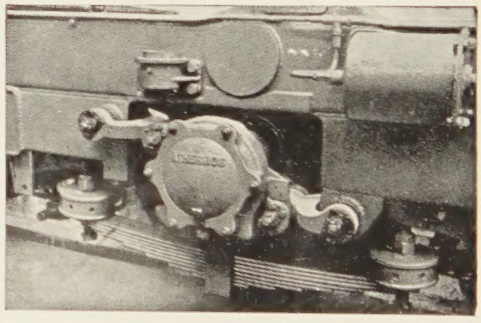

S. N. C. F. electric locomotive C. C. nº 7001 Details of the suspension

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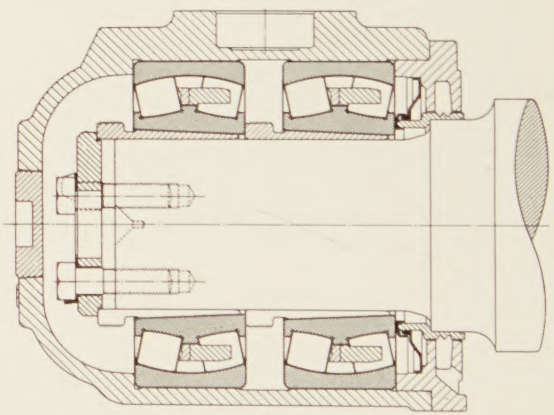

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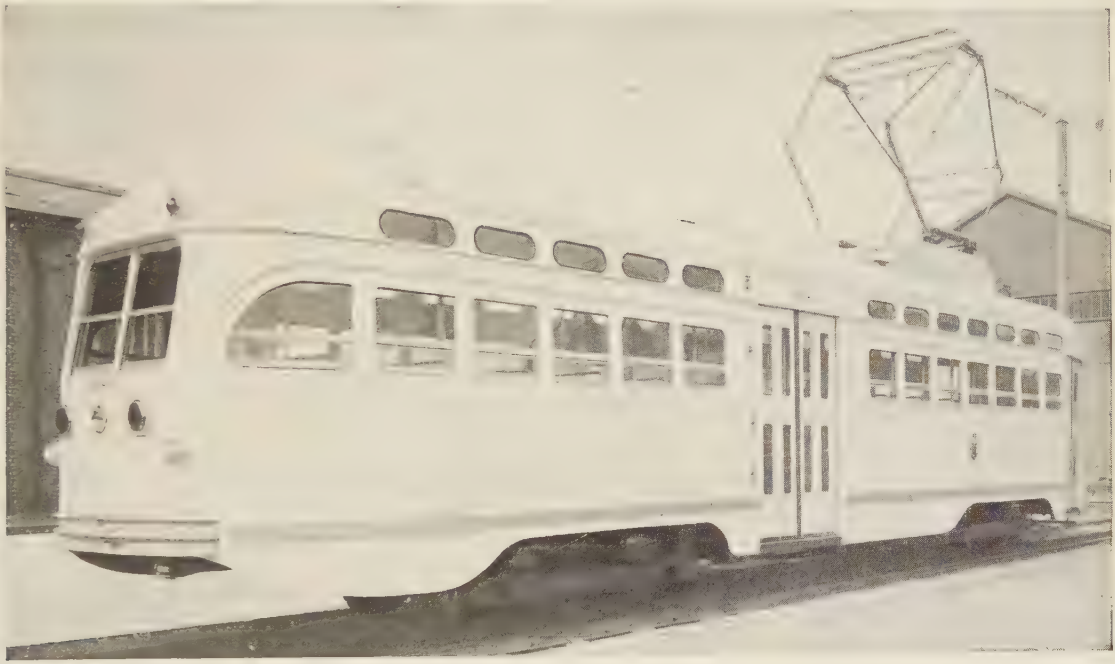

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SJÖBERG (Arne). — **Economic aspects of : a) discontinuing service on old railway lines; b) construction of new railway lines; with regard to the possibility of handling transport with other means.** (Question III, Enlarged Meeting of the Permanent Commission, Stockholm, 1952). Report *(America [North and South], Australia [Commonwealth of], Burma, China, Ceylon, Denmark, Egypt, Finland, India, Irak, Iran, Irish Free State, New Zealand, Norway, Pakistan, South Africa, Sudan, Sweden, United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible). (continuation and end.)* (57 000 words, tables & fig.)

Note. — This contents sheet is appended t

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OF THE

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(ENGLISH EDITION)

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An edition in French is also published.

Vol. XXIX. — No. 4. April 1952.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[385]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

ENLARGED MEETING OF THE PERMANENT COMMISSION
(STOCKHOLM, 1952.)

QUESTION III.

Economic aspects of :

a) discontinuing service on old railway lines;

b) construction of new railway lines;

with regard to the possibility of handling transport with other means.

REPORT

(Continued.)

(America (North and South), Australia (Commonwealth of), Burma, China, Ceylon, Denmark, Egypt, Finland, India, Irak, Iran, Irish Free State, New Zealand, Norway, Pakistan, South Africa, Sudan, Sweden, United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible),

by Arne Sjöberg, M. A.,
Chief Research Economist, Swedish State Railways.

V. Economic and technical changes in transportation and their influence upon economic activity and distribution of various types of traffic.

Economic and technical changes in transport facilities, serving to alter transport costs and the quality of transport services, entail corresponding tendencies to changes in the relative prices of different commodities and in the regional distribution of production, as well as in the conditions of competition between the various means of transport.

After World War I, the railways were confronted with immense problems of adaptation. Their personnel and rolling stock were largely commensurate with the intense traffic of the war years, and hence

the economic problem consisted in an adjustment to the substantially lower post-war traffic density. The work of rationalization that was then initiated has since proceeded without interruption. Yet some of the constant improvements, rationalization measures, and simplifications carried through by the railways might also be attributed in part to the efforts to meet the increasing public demand for high quality and inexpensive railway services. Moreover, the steadily mounting road traffic has been of some significance as a factor prompting rationalization measures on the railways.

This rationalization work of the railways, like that of industry, has been designed to secure lower production costs by the following types of changes in the structure of production.

1) *Standardization,* and limitation of the number of types of locomotives, cars, and all spare parts for the same, as well as permanent way, automatic signalling, telephone installations, etc.

2) *Specialization* of production, e. g. by the introduction of direct merchandise cars, freight trains for long-distance transport, etc.

3) *Concentration* of production to a small number of operating units, e. g. by amalgamation of stations, main depots, etc. This includes the closing down of certain operating units, i. e. of stations or lines that have lost their importance.

Concentration has also occurred in respect of train operating and car hauling, in that every possible effort has been made to avoid car hauling on secondary lines with unfavourable operating costs, and instead to concentrate it to the main lines with their more mechanized and efficient facilities, larger trains, and hence more favourable operating costs. Notwithstanding the lengthening of routes, such routings of cars have meant lower operating costs and faster services. The declining importance of branch or secondary lines as feeders to the mainlines, due to the expansion of road traffic, has amplified still further this concentration of car hauling to the main lines for economic reasons. The progressive increase of this tendency to concentrate is evident from *Fig. 1,* which shows the « concentration curve » in respect of gross ton-km for the Swedish State Railways in 1899, 1924, and 1949. A similar mounting concentration of traffic is also noticeable in respect of the stations as « points of collection and dispersal » of freight and passengers.

4) *Mechanization* of production by the use of machinery and other technical facilities. Typical examples are the introduction of the air pressure brake, electrification of lines, electric signalling and shunting devices, machines for way maintenance, etc.

5) *Organization* of resources by seeking to coordinate and supervise the existing technical and staff resources as rationally and effectively as possible. Hence railway organization has adapted itself to technical advances in its special field.

To a certain extent the railways' work in the field of rationalization and economy has been closely dependent on technical advances, and therefore has coincided in some measure with the development of railway technics more or less by leaps and bounds. Yet on the other hand that development is determined to some degree by the actual need of technical simplifications and improvements.

The rationalization measures of railways have been taken in part under different conditions. In certain cases more effective working methods have been carried through, by mechanization or by other means, regardless of external influences. But in other cases the primary aim has been to keep the various installations up to date in the face of changing conditions — above all in the magnitude and density of traffic — though at the same time every bit of experience and every possibility of reducing operating costs have been utilized. It seems debatable, therefore, where the

limit should be drawn between purely rationalization measures and changes necessitated by modernization or enforced adaptation.

In surveying the significance of technical advances in this rationalization work, attention should be drawn to the following, which have been of exceptional importance to the operating economy of the railways; namely, the introduction of the air pressure brake, the electrical and Diesel-electrical operation of lines; rail buses with internal combustion engines, and modern shunting and signalling devices.

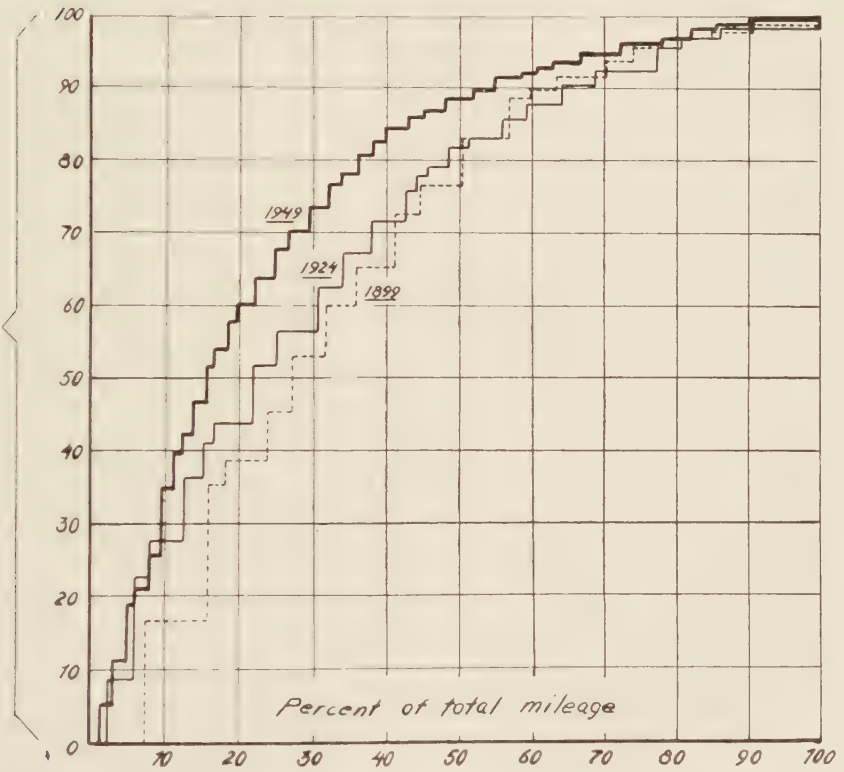
Moreover, technical progress in general has naturally had a pronounced influence on working conditions and has made possible various kinds of rationalization schemes. Suffice to mention here the introduction of electric lighting, telephones, welding, machine tools, typewriters, and calculating, accounting, statistical, and ticket machines, etc.

The increasing availability of cheap or

Figure 1

THE GROWING CONCENTRATION OF TRAFFIC ON THE

SWEDISH STATE RAILWAYS



rapid transportation (railways, highways, waterways, pipelines, etc.) has made it possible for industry to extend both its supply areas, providing materials from widely scattered sources, and its market areas, distributing products to consumers at great distances from the production site. The improvements in transport methods during the last century, especially through the railways, have contributed to the development of mass-production methods and regional specialization of production, and have made possible industrial development in areas at greater distances from the raw materials necessary for production.

The location of industrial activities is governed by different factors. Among the chief of these are proximity to markets and sources of raw materials, access to fuel or power, labour supply, etc. Some of these factors, such as the first named, are largely dependent upon transportation, and influence location through the costs of transporting products and raw materials, the effect of these costs varying with the length of the haul and the structure of transport rates. Other factors, e. g. supply of labour, are only indirectly dependent on transportation. The importance of transport costs varies considerably in different industries. For industries where the proportion of transport costs is large in relation to total production costs and to value of products, transport costs may be the factor determining choice of location. On the other hand, if transport costs are small in relation to production costs and value of products, they may have practically no influence at all on that choice.

This influence may be summarized as a tendency to localize industry to a site where the aggregate transport costs in securing the raw materials and distributing the products are the lowest possible. This may be either at the source of some important raw material, or at the market for the product, or it may be at some intermediate site.

Locational advantages with regard to transport costs may be outweighed by other factors such as cheaper labour, local subsidies and concessions concerning taxes, credits, grant of land, etc.

Agriculture and most other extractive industries are of necessity closely bound to the resources exploited. In some cases, however, when these resources are widely spread over the country other factors too may have a great influence on the choice of location.

Service industries are for the most closely oriented to consumer-markets or administrative agglomerations. Some service industries, e. g. administration, are mainly localized to major urban centers.

The localization of manufacturing industries is quite heterogeneous. Some are closely related to their markets, and thus have about the same distribution as most of the service industries. In other industries, sites with a sufficient supply of labour, in some cases with a specialized skill, or with an adequate supply of cheap power of fuel, determine the choice of location. Lastly some industries, usually because much of the raw material is lost in processing, are established near the source of materials. In some instances, however, the location of an industry in a certain place may be attributed to chance.

When, through motorization, road transport had its renaissance at the end of the first decade of this century, economic life in the industrialized countries had largely adapted itself to the transport situation, which was characterized by the large-scale expansion of railway networks. In this situation, dominated by the railways, the advent and progressively mounting importance of road transport was to entail manifold, and in part far-reaching, changes both in competition on the transport market and in the requisites for localization of economic life. The advent of railways implied a revolutionary fall in the costs of land transportation. This fall naturally had the greatest effect in places served by railways, the repercussions being less pronounced in the outlying regions, since transport to and from railway stations still had to be effect-

ed by horse-drawn vehicles or, in some cases, by waterway. The advent of motorized land transport, which had access to a widely ramified system of highways, was to bring about an improvement in transport conditions and a fall in transport costs, mainly in such places as were not served by railways. For railway traffic this advance of road transport entailed a general expansion of the areas using railway stations, permitting collection and distribution of passengers and freight over greater distances than before. Road transport thus served to balance in some degree the transport costs in places served by and places not directly served by railways. Due to the rapid expansion of road communications in most countries, and to the swift technical progress of motor engineering, motorized road traffic — which at the outset had been used solely for local transportation, in which field it speedily ousted horse-drawn vehicles, and for haulage to and from railway stations — was soon to be augmented so as to compete with the railways for transports over increasingly long distances. In this way there occurred a far-reaching equalization of the previous differences in transport costs for different places.

Passenger cars and buses have increased the range of travel of labour and made possible the location of manufacturing plants on suburban and rural sites. During the past few decades new industries have to a great extent been localized to the outskirts of the larger urban centers. This tendency to decentralization of industry and population is often called suburbanization. On the other hand the improvements attributable to passenger cars and buses in passenger transportation have widened consumer markets, diverting retail trade from smaller population centers to larger centers in urban areas and thus intensifying the urbanization of industry.

Motor truck traffic has to a large extent been selective as to the commodities it handles, and in a general way it may be said that truck traffic seeks revenue rather than tonnage. This selective selling of transport services by trucks, which railways often call « skimming the cream », is particularly directed to finished and manufactured commodities rather than raw materials, and to consumers' goods rather than capital goods.

For some commodities, on certain distances and in certain connections road transport often has special advantages over rail transport. Some of the reasons why shippers may prefer trucks instead of railway service are given in a study by the U. S. Federal Coordinator of Transportation (1). A number of shippers, being asked why they patronized trucks, gave the following reasons. (In most cases more than one reason were given by the shippers; hence the sum of percentages exceeds 100.)

	Per cent of shippers influenced	*Per cent of total tonnage controlled by influenced shippers*
1. Store-door delivery . . .	65	67
2. Faster over-all service . .	65	73
3. Cheaper total cost . . .	53	67
4. Store-door pick-up . . .	51	54
5. More flexible or convenient service	43	61
6. Cheaper packing costs . .	21	27
7. Late acceptance of shipments	21	26
8. Simpler classification of rates	16	25
9. Less damage to or loss of freight	11	14
10. Personal friendship or interest	3	3

The shippers were also asked to state the disadvantages that, in their opinion, attended the use of motor trucks. The reasons

(1) U. S. Federal Coordinator of Transportation : Merchandise Traffic Report (1934).

given and the relative importance of these disadvantages were as follows :

	Per cent of shippers influenced	*Per cent of total tonnage controlled by influenced shippers*
1. Lack of responsibility . .	25	29
2. Failure to maintain regular schedules	16	15
3. Lack of uniform or definite rates	12	16
4. Charges too high	10	12
5. Pick up or delivery inconvenient	7	5
6. Excessive loss or damage .	3	2

The attitude taken by these shippers and the reasons given by them for preferring or not preferring truck transport to railway transport might reasonably be assumed to characterize the present situation in most industrialized countries. In this connection another American study of the advantages and disadvantages of using motor trucks may be of interest. This study ([1]) shows the attitudes of producers and dealers to the use of trucks in marketing fruits and vegetables.

The advantages of motor trucks were given as follows :

1. Faster service.
2. Convenience and saving in labour.
3. Better condition of product on arrival.
4. Early delivery to market with maximum time for preparing shipments.
5. Greater opportunity for diversion of product.
6. Less loss for shortages and damaged packages.
7. Promptness in payment of claims.
8. Lower transportation costs in local territory.
9. Agreements to pay for loss of early market.
10. Return of empty crates.
11. Increased sales to retailers.
12. Intimate touch with market through truckman.

([1]) PRICE : The Motor Truck as a Carrier of Fruit and Vegetables to Greater New York. New Jersey Agricultural Experiment Station, Bulletin No. 503.

The disadvantages of using motor trucks were stated as follows :

1. Lack of advance market information.
2. Absence of proper regulation of responsibility of operator, regularity of schedule, and standardization of rates.
3. Necessity for immediate sale or storage.
4. Terminal market congestion.
5. Rising transportation charge with increasing distance.
6. Lack of opportunity for shipping point inspection.
7. Interrupted service resulting from unfavourable weather.
8. Miscellaneous disadvantages such as breakdowns, lack of insurance, delay in market, etc.

In high-speed merchandise traffic on shorter distances, motor trucks are in many ways superior to railway service through their greater ability to effect direct store-door collection and delivery of freight, their often more liberal packing requirements and their greater ability to adapt the service to the needs of each individual shipper.

There is, in certain sectors of production and especially of distribution, a tendency to an increasing shift from heavy commodities to lighter ones, from bigger shipments to smaller ones, and from longer hauls to shorter. Together with the growing emphasis on speed and flexibility these tendencies have meant a gradual increase in volume and extension to longer hauls of truck transports particularly for business where terminal handling at origin and destination is important.

The essential advantage of truck transport often consists in its greater ability to furnish an overnight delivery. The principal reason for the greater speed of truck service is that it can collect freight at origin at the store-door and deliver it at destination at the store-door with a minimum of reloadings. In this connection the following may be quoted from a study made at Yale University several years ago ([1]) :

([1]) TALBOT : « Why Shippers Use Trucks ». *Railway Age*, 1931, II, p. 485.

« Motor trucks are able to provide overnight delivery, while the rail carrier cannot, because of the greater operating flexibility of trucks in terminal areas. The practice of the larger trucking companies is to operate their trucks over the road during the night when other traffic is comparatively light. Truck-load shipments move direct from plant to consignee's store door. Less-than-truck-load shipments move to the freight transfer station which the larger trucking companies maintain, where each shipment is transhipped to a small or local delivery truck serving the particular territory to which that special shipment is bound. Less-than-carload shipments moving via rail require local motor truck delivery to the freight station at the originating end, and to the consignee from the railhead at the receiving end. This procedure is time-consuming. Another delaying factor is that most railroad freight stations have definite opening and closing hours, and the local cartage service must conform thereto. Carload shipments moving via rail, especially in New York, generally require involved switching moves, which often consume much time, to reach the consignee's plant. In addition, direct delivery requires that the consignee have a rail connection. Such basic characteristics as these explain the difference in the shipping time which these two means of transportation require for movement between the cities involved. »

« The more outstanding economic consequences that make the factor of overnight delivery so important are listed below :

» *a*) it allows jobbers and dealers (the consignees) to carry reduced inventories and stocks;

» *b*) it eliminates the necessity for large storage facilities or for warehousing, thus allowing the consignee to order in small lots instead of in carload lots as formerly;

» *c*) it allows production to be scheduled to fill orders rather than to maintain complete stocks, which makes for direct savings to the manufacturer, who is also generally the shipper. »

The handicap of the railway in furnishing overnight delivery and store-door collection and delivery has been lessened during the past few decades in many countries through the running of express freight trains and other improvements in train schedules, use of freight containers, establishing of coordinated rail-truck service and substituted truck service to speed up shipments of merchandise freight, arranging of store-door collection and delivery by the railway in most localities, etc.

The factor largely responsible for the favourable competitive position of road transport in relation to rail transport lies in the greater possibilities for the former to effect passenger and freight transport from door to door. In goods traffic this implies that consignors not localized to railway stations, or having no direct communication with railway lines, require a combined service, with road transport at the terminal points of the rail transport, if they are to secure door-to-door facilities; whereas truck transports can usually be effected directly from door to door.

In such combined services the costs of rail transports are thus increased by one, or possibly two, terminal transports by truck, and by one, or possibly two, rehandlings of the freight. In view of these terminal transports and rehandlings, combined transport especially in the case of short-distance rail carriage, is more expensive than direct road haulage. The substantial changes in competition between rail and road transport that may occur in such cases have been exhaustively treated in a work on location theory by Prof. T. Palander [1].

The manner in which the relative magnitudes of transport and rehandling costs influence the choice between direct road transport and combined rail-road transport, the aim being to secure the lowest total cost for door-to-door transport, has been schematically illustrated by Palander in some cartograms which are reproduced in the following. To facilitate an analysis, certain simplifications have been introduced. The cartograms show an area traversed by a straight railway line (A-A) on which the stations are assumed to be so

[1] Palander : *Beiträge zur Standortstheorie*, Uppsala, 1935.

close to each other that we can disregard the distances between them (« homogeneous transport line »), and served by motor-truck transports throughout the area. It is further assumed that the highway network in the surrounding zone is so dense that a road approximating to a straight line can always be chosen for transports between two places (« homogeneous transport area »). Yet another postulate is that the freight charges for both means of transport (railway and truck) are proportional to the distance.

These simplifications are probably in several cases, fairly consistent with the factual conditions, particularly in such regions where competition between rail and road transport is intense. In older, more highly developed countries at least, the road network corresponds to such a homogeneous transport area insofar as road communications exist between all places with fairly substantial traffic. The deviations from such a hypothetically idealized transport area lie mostly in the fact that the standard of roads varies considerably and that the distances by road are longer than those as the crow flies. With regard to railway lines this simplifying assumption is tantamount to disregarding the fact that railways actually constitute a series of points (stations) between which transport facilities exist. However, the assumption should be fairly consistent with the de facto conditions, since the distances between stations on one stretch of line are short. The longer the distances between stations on one stretch, the poorer will be the transport facilities for places located close to railways but between stations.

The two upper cartograms, *Figures 2 and 3*, show the geographic allocation of transports between direct road and combined road-rail transports to or from points located on a railway line (denoted by an asterisk). The two lower cartograms, *Figures 4 and 5*, illustrate the corresponding conditions in transports to or from places situated at a certain distance from the railway line.

In *Figures 2 and 4* the freight costs per ton-km of road transport are assumed to be 100 % higher than of rail transport, but in *Figures 3 and 5* only 25 % higher. In the case of rehandling the costs of loading and unloading are assumed to correspond with those of road transport over distance R (specially marked on the figures).

Direct road transports are cheapest to and from all places situated in the white zones on the cartograms. The zones marked with closely spaced and widely spaced lines denote those places to or from which combined transport is the most advantageous when no rehandling costs occur. The former zones indicate such places for which combined transport is cheapest even allowing for rehandling costs of the magnitude indicated; the latter zones thus correspond to areas which, by virtue of rehandling costs, use direct road transport instead of combined transport.

A comparison of these cartograms shows how the fall of truck freights in relation to railway freights during recent decades has influenced competition between rail and road transport. For if we compare *Fig. 2* (rate levels : rail 100: truck 200) with *Fig. 3* (100 and 125 respectively) — i. e. cases in which at least one of the places of despatch or destination is situated on a railway — or *Fig. 4* (rate level : railway 100: truck 200) with *Fig. 5* (100 and 125 respectively) — i. e. cases in which at least one of the places of despatch or destination is *not* situated on a railway — we find that in both instances a fall of truck charges in relation to rail charges leads to a considerable expansion of the area covered by direct road transports. This expansion is very substantial even if we do not reckon with any rehandling costs. A large proportion of short-distance traffic thus goes over to direct road transport (the increase of the white zone in *Fig. 2* compared to *Fig. 3*, and in *Fig. 4* compared to *Fig. 5*, is considerable). This tendency is even more pronounced if we take into account rehandling costs, in which case the widely spaced zones too go over to direct road

Figure 2

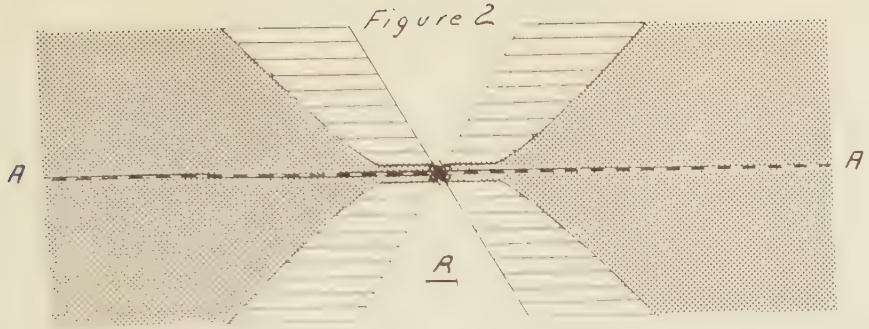


Figure 3

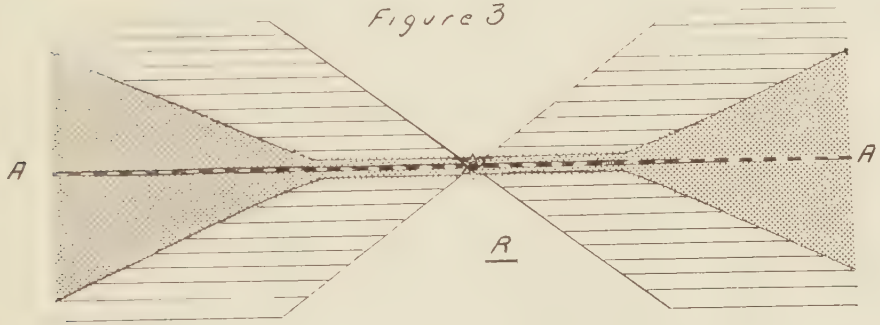


Figure 4

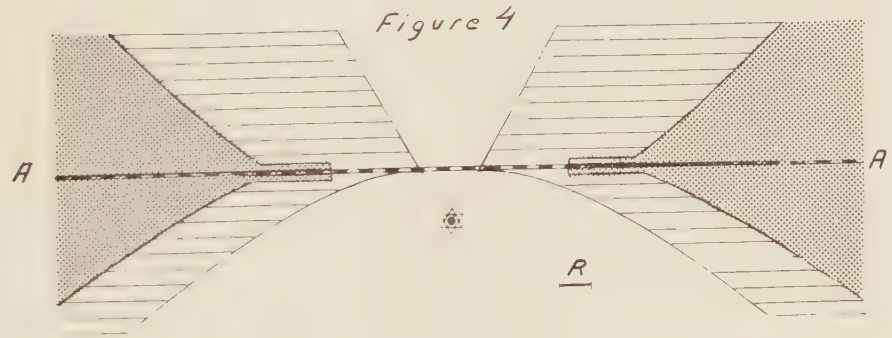
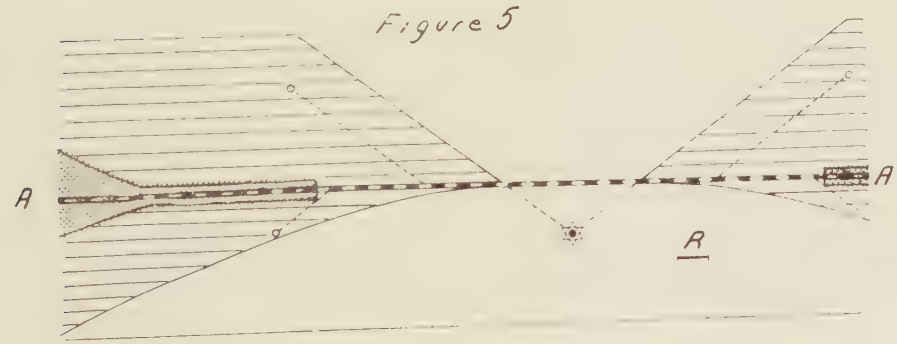


Figure 5



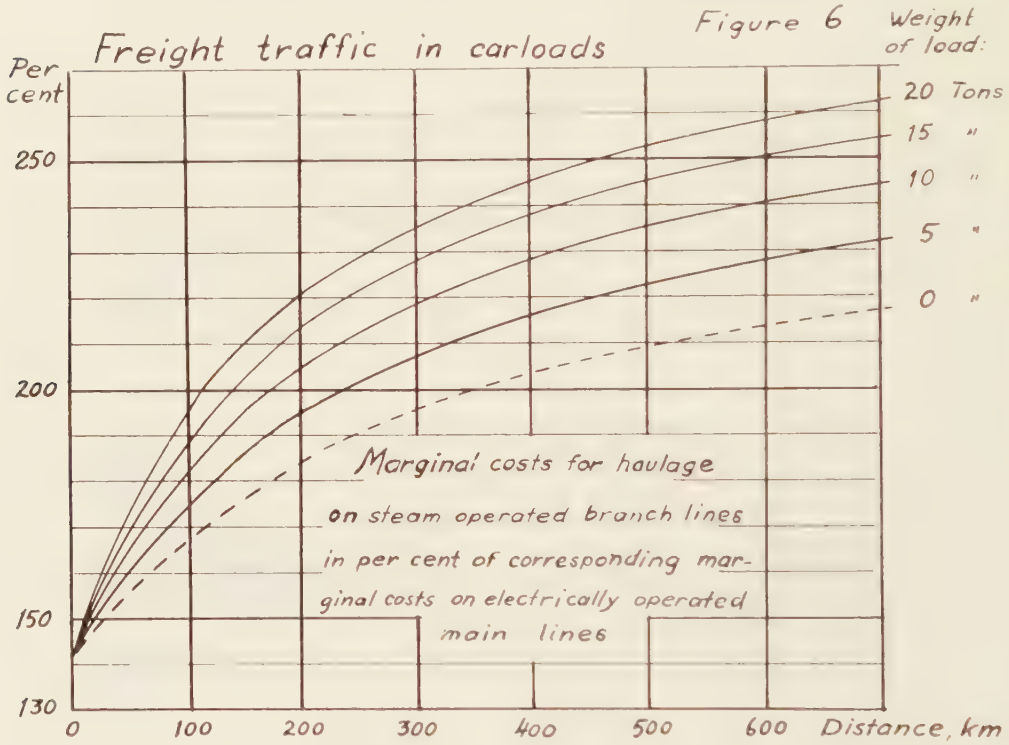
transport. The expansion of the direct road traffic zone, especially in such cases where at least one of the places of despatch or destination is not situated on a railway (*Fig. 4* compared with *Fig. 5*) will be so substantial that virtually all the short-distance traffic will accrue to road transport.

The aforegoing holds good, of course, only on the assumption that the truck charges postulated here are higher than the railway charges; otherwise all transports would accrue to the road traffic. The road transport charges may often be lower, especially in short-distance haulage, than the rail charges for commodities which, in accordance with the railways' value tariffication have been placed in the highest tariff grades; and likewise in such traffic relations where the traffic is substantial, regular, and well balanced in both directions.

The actual allocation of traffic between rail and road is determined by a country's economic and geographic structure in various respects; the density of population, of railways, and of roads, the distances between different centres of population and economic life, the structure of economic life, the relative rate levels, the trend of rate policy in respect of rail and road transport, etc. The more the economic life and population are localized to districts served by railways, the greater the proportion of the total traffic volume that is represented by long-distance transports or transports of bulk freight, and the lower the rail charges in relation to truck charges, the greater may be expected to be the railway's share of the total traffic volume.

In the operation of railways the fixed and common costs predominate, and to

Figure 6



cover them the railways are usually obliged markedly to differentiate the price for their transport services on the principle « to charge what the traffic will bear ». In road transport, which is composed of a large number of small concerns each with a few trucks, and in which variable costs predominate, the possibility and the need of price differentiation analogous to that of the railways will be considerably less, and the possibility of estimating the costs of each particular transport will be greater. Broadly speaking, it is the costs that determine haulage prices in road transport. Hence the tariffs are usually proportional to the weight of the goods and the distance transported.

Thus road transport tariffs differ in several respects, of importance from the standpoint of competition, from those of the railways. No value tariffication like that of the railways, occurs as a rule; rather the rates may be chiefly based on covering the costs of each transport, plus a certain margin of profit. The differences that occur in road transport rates for different commodities are usually due, therefore, not to any value tariffs but to the fact that various types of goods, by virtue of their volume, weight, shape, fragility, etc., entail varying costs for the road transport concern. Truckers, unlike railways, are not bound to any uniform tariffs for all times of the year (« uniformity in time ») and for all sections of the network covered (« uniformity in space »); rather they can, individually, adjust the tariffs to each particular transport or to transports the costs of which approximate to each other. Hence road transport is in quite a different position than rail transport with regard to the possibility of basing its tariffs, where required by virtue of competition, on the costs of each particular transport assignment.

This uniformity in time and space of railway tariffs means that transports which may differ considerably in respect of costs will be charged according to the same tariff, even though the transport costs may vary substantially from line to line and from season to season, by virtue, inter alia, of the traffic density, form of power (electric, steam), course of the line, etc. The difference in transport costs between haulage of carloads on steam-operated branch lines and haulage on electrically operated main lines is illustrated in *Fig. 6*, where long-run marginal costs of haulage of various carloads (0, 5, 10, 15, 20 tons) for various distances on steam-operated branch lines are given in per cent of the corresponding marginal costs on electrically operated main lines.

As has already been intimated a basic difference between road and rail transport tariffs — which, however, has been eliminated to some extent in recent years — consists in the fact that railways usually apply value tariffs in their freight traffic, at least with regard to carloads. Thus the commercial value of the goods has largely determined whether high or low tariffs will be applied. In road transport tariffs, on the other hand, the value of the goods is not usually taken into account; the costs, and considerations of competition, are the determining factors. On lines with heavy volumes of traffic, where railways can enjoy the various advantages of large-scale operations, the marginal and average costs of executing transport assignments will naturally be very low, wherefore the uniformly applied tariffs will be relatively greatly in excess of them. But on lines with low volumes of traffic, where small-scale operations are the rule and the marginal and average costs therefore will be relatively high, the costs will be equal to, or indeed considerably higher than, the tariffs. Competition from road transport is primarily directed to the more profitable railway transports, i. e. those between large towns and other major agglomerations. In such instances truckers can count on regular assignments and well-utilized load capacities in both directions, i. e. lucrative business. Because the railways are to a large extent bound by uniform tariffs over the entire network and at different times

of the year, and because of the value tariffication railway tariffs on such lines with heavy volumes of traffic will be relatively high in relation to the transport costs. Hence road transport companies will often be in a position to compete with railways for relatively long-distance work too, even though road transport costs are higher than rail transport costs. On lines with low volumes of traffic, on the other hand, road transport concerns usually have not the same incentive or ability to compete with the railways, since their costs, due to small loads, lack of return freights, etc., will often be relatively high, whereas the uniform railway rates in such cases are low in relation to both road transport costs and the railway's own transport costs.

Railway rates are usually « station-to-station » rates and the service of carting the freight between the traders' premises and the railway stations is not included in the standard rates. Road motor traffic charges for truckloads generally comprise transport between the traders' premises, from door to door, which, as mentioned earlier, is of an important advantage to motor truck traffic in their competition with the railways. But to a great extent the traders' premises are localized at the railway stations or connected to them by sidings. In such cases no transfer is required between the stations and the traders' premises, and so the transport services can be discharged at « station-to-station » rates, here abbreviated to « *SS-rates* ». If only one or none of the traders' premises is situated on the railway, there are added charges for collection or/and delivery of the freight. These rates could be denoted as « station-to-door » or « door-to-station » rates, here abbreviated to « *SD-rates* », when to « SS-rates » are added charges for transfer at one end of the railway haul between the stations and the traders' premises, and as « door-to-door » rates, here abbreviated to « *DD-rates* », when to « SS-rates » are added charges for transfers at both ends of the railway haul between the stations and the traders' premises.

The state of competition and the allocation of traffic between railways and trucks are also to a great extent due to the utilization of the load capacity of the railway cars and trucks used and to the possibility of obtaining return loads. Trucks often have certain technical advantages in this respect by their possibility of using vehicles of different load capacity for loads of different weight. Railway cars on the other hand generally have a standardized load capacity. The possibilities of obtaining return loads for railway cars or trucks are determined by the size, structure, and regularity of the traffic and by the efficiency of their selling organizations.

A general view of the development of the state of competition for carloads respectively truckloads in respect of differences in the possibilities of establishing door-to-door service, differences in the relative degree of utilization of load capacity, differences in the possibilities of getting return loads, differences in the rate systems (value respectively cost tariffication) will be had from the numerical model given in *Fig. 7-15* and in *Table 13*.

This model, in essentials built on actual conditions in Sweden, gives for the railway estimated long-run marginal costs for haulage of carloads of 5, 10, and 15 tons (equivalent to a degree of load capacity utilization of 25, 50 respectively 75 % of a car of 20 tons maximum load) on electrified main lines with addition in actual cases of costs for collection and delivery within a zone of maximum 5 km.

It has for truck transport been calculated with average total costs for haulage of truck loads of 5, 10, and 15 tons on trucks of a load capacity of the same amount, equivalent to a degree of load capacity utilization of 100 % in each case.

It has not been possible to take into consideration the circumstance that truck taxes especially for heavier trucks in great probability are insufficient to cover their share in the costs of road wear, etc.

The costs of railway and truck services have further been calculated for three dif-

Figure 7

TRANSPORT CHARGES AND COSTS
BY RAILWAY AND BY ROAD

Station-to-station charges and costs

Size of consignment : 5 tons

Sw. crs.

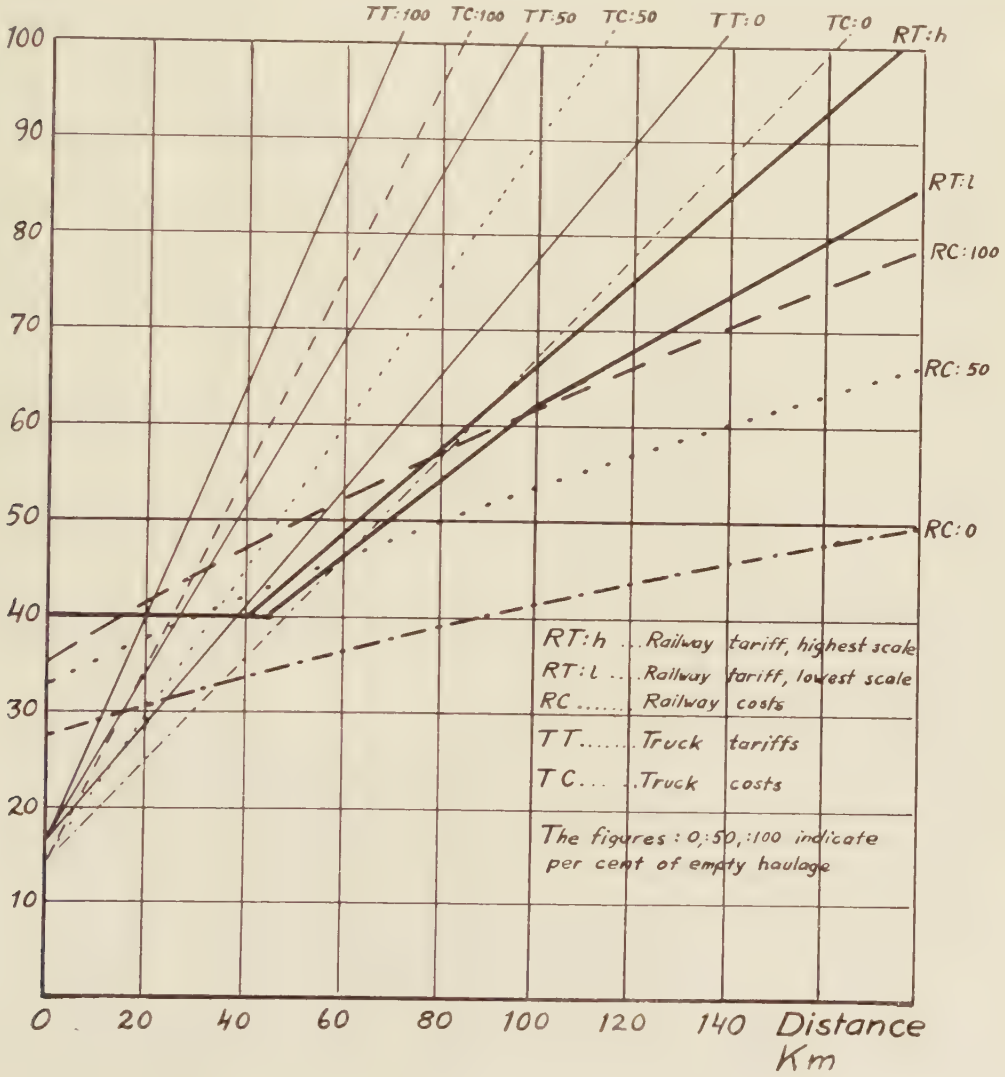


Figure 8

TRANSPORT CHARGES AND COSTS BY RAILWAY AND BY ROAD

Station-to-station charges and costs

Size of consignment : 10 tons

Sw. crs.

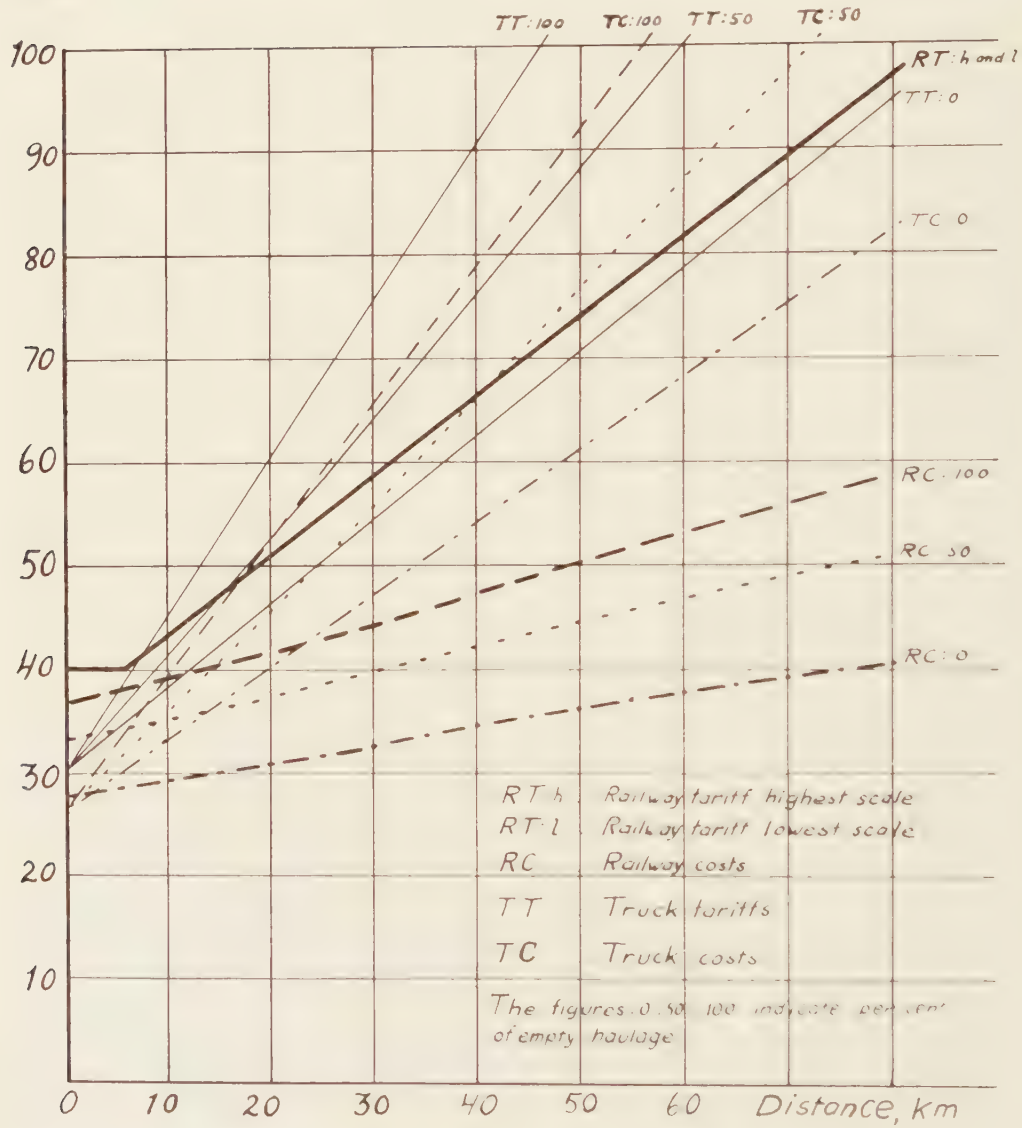


Figure 9

TRANSPORT CHARGES AND COSTS
BY RAILWAY AND BY ROAD

Station-to-station charges and costs

Size of consignment : 15 tons

Sw. crs.

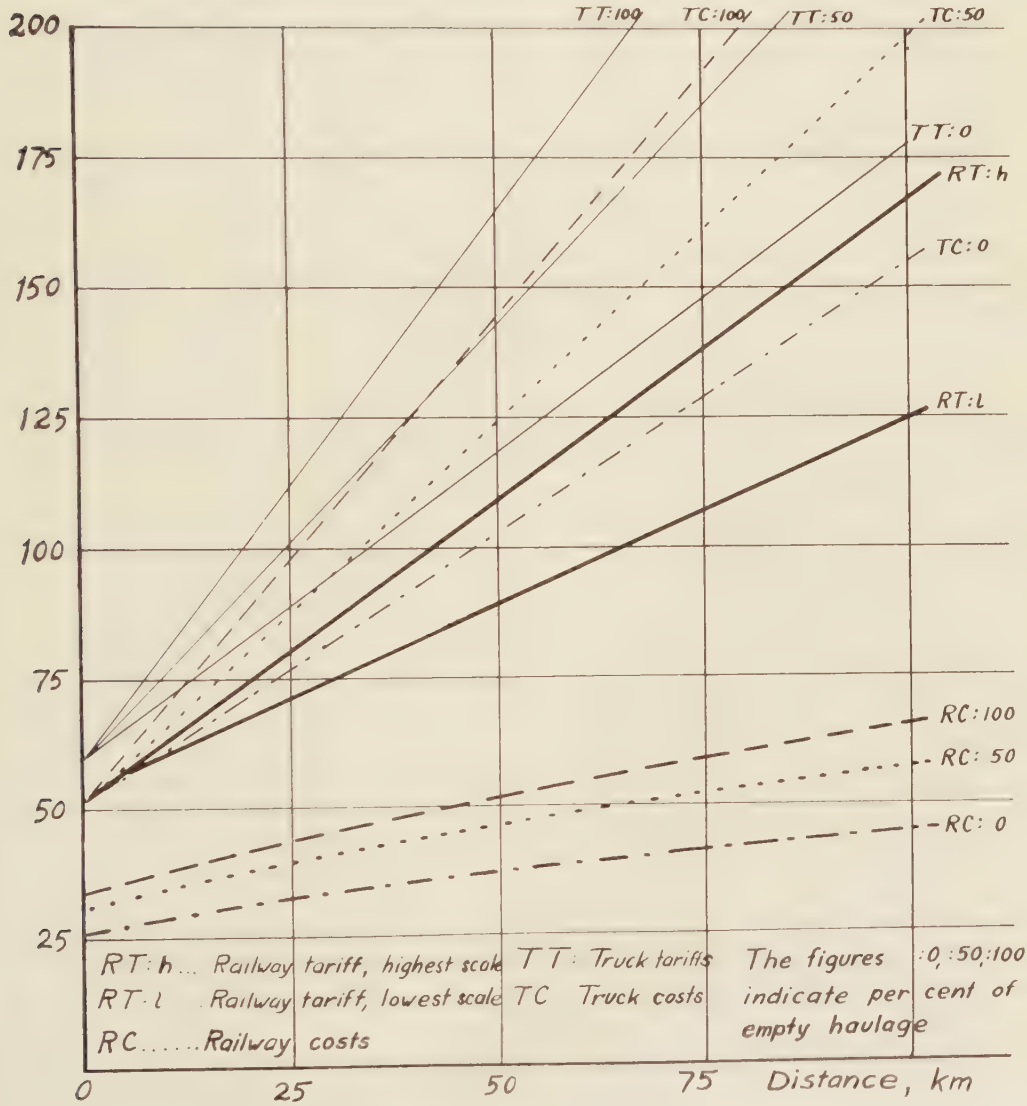


Figure 10

TRANSPORT CHARGES AND COSTS BY RAILWAY AND BY ROAD

Station-to-door charges and costs

Size of consignment : 5 tons

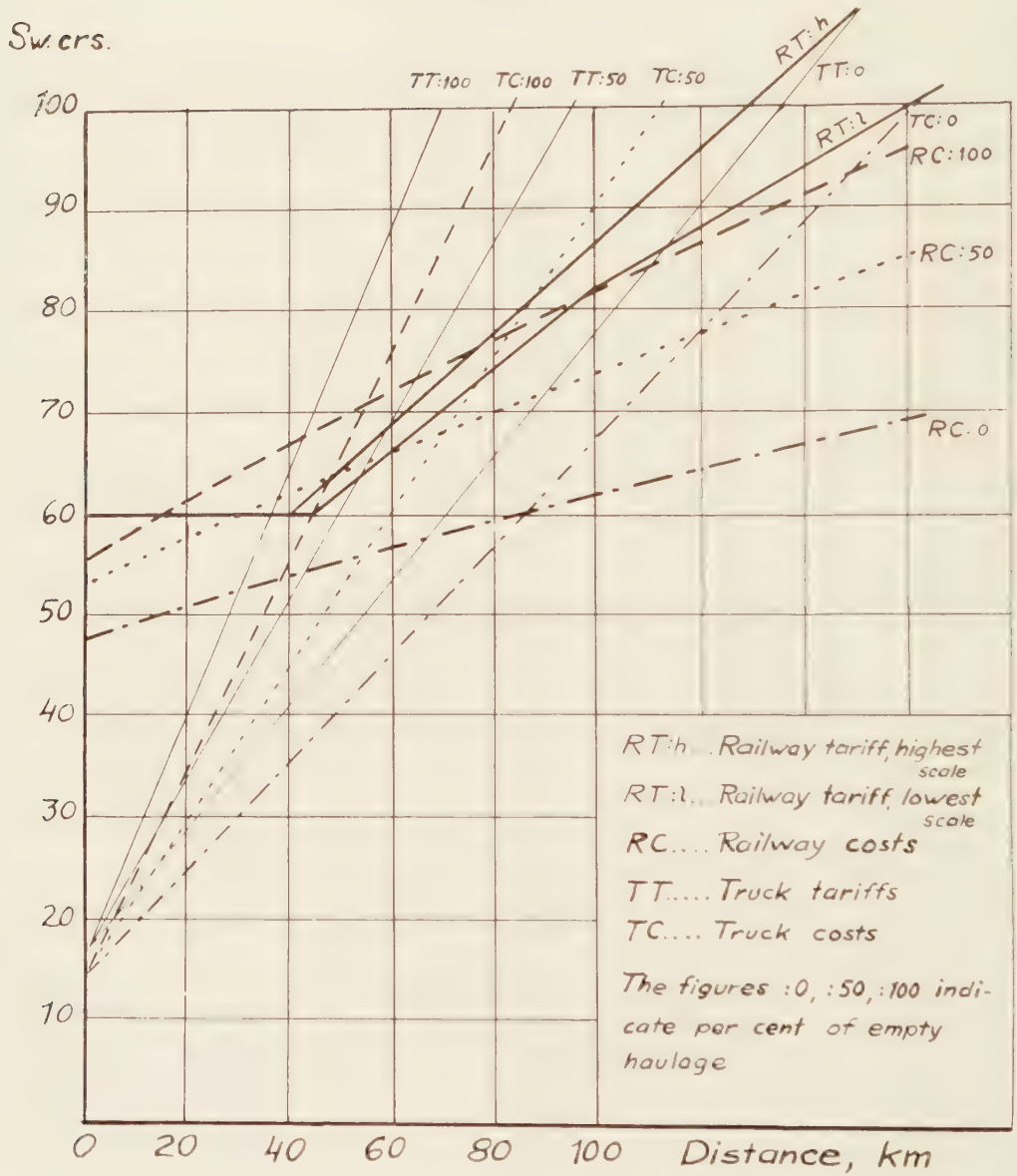


Figure 11

TRANSPORT CHARGES AND COSTS BY RAILWAY AND BY ROAD

Station-to-door charges and costs
Size of consignment : 10 tons

Sw. crs.

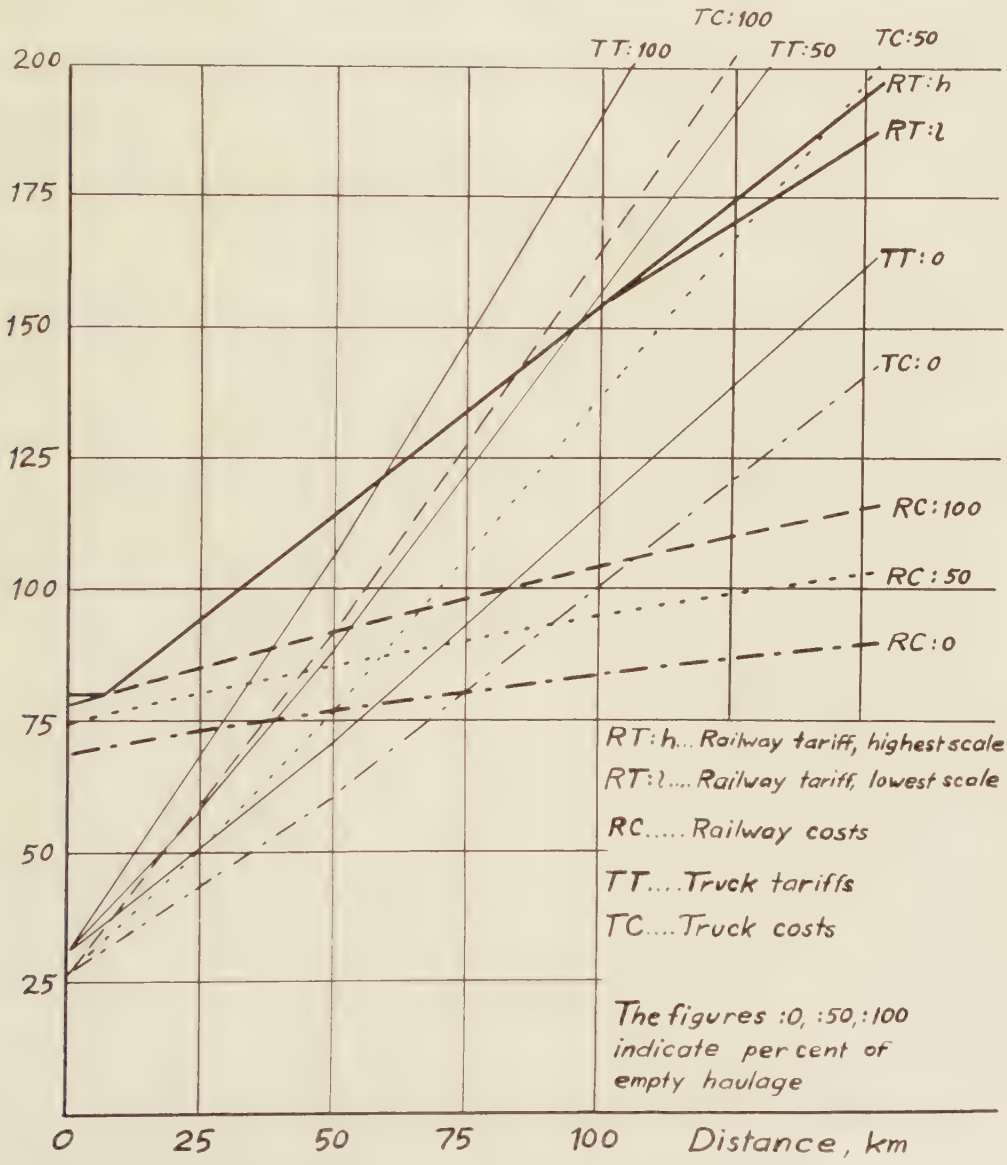


Figure 12

TRANSPORT CHARGES AND COSTS BY RAILWAY AND BY ROAD

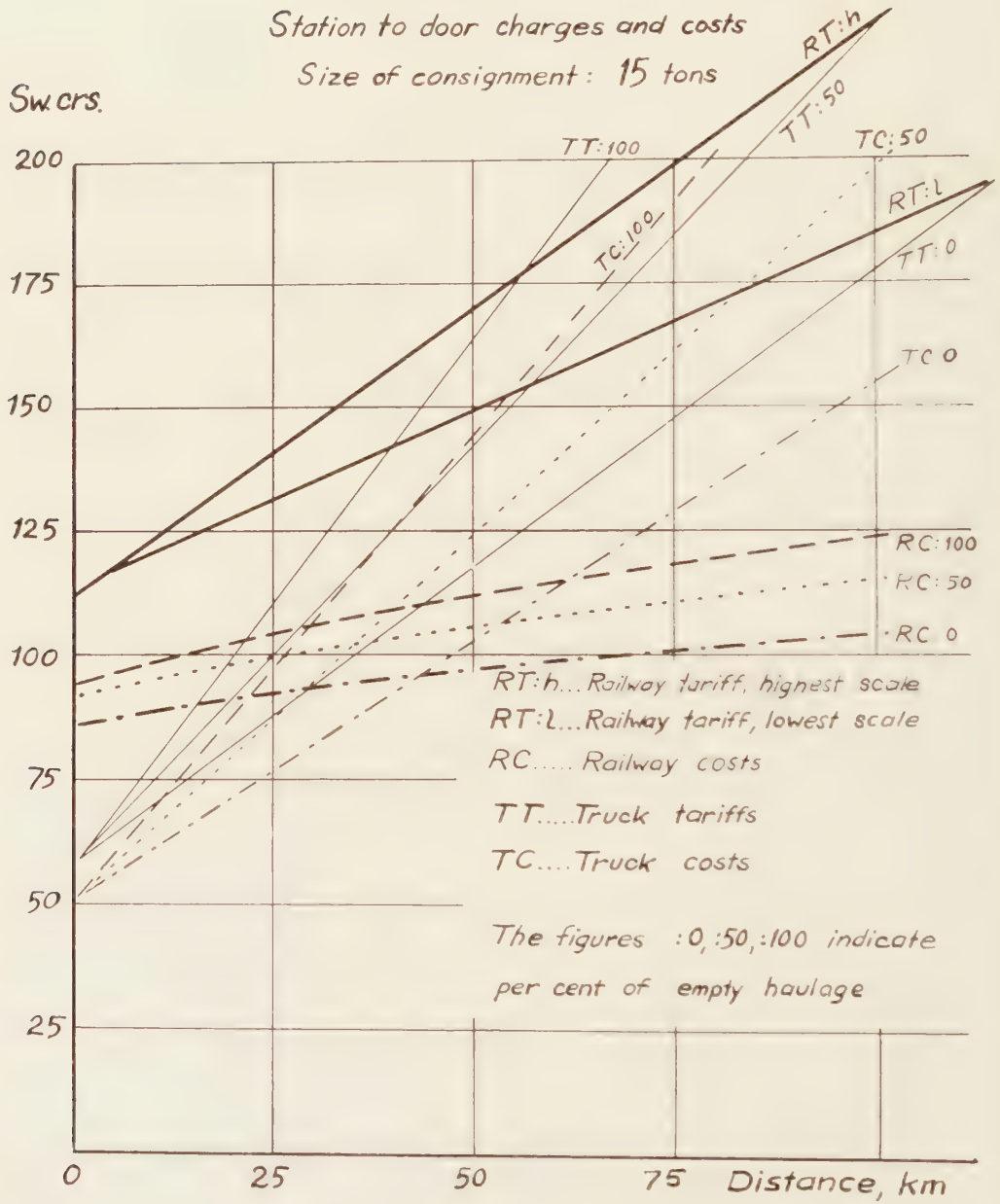


Figure 13

TRANSPORT CHARGES AND COSTS
BY RAILWAY AND BY ROAD

Door-to-door charges and costs

Size of consignment : 5 tons

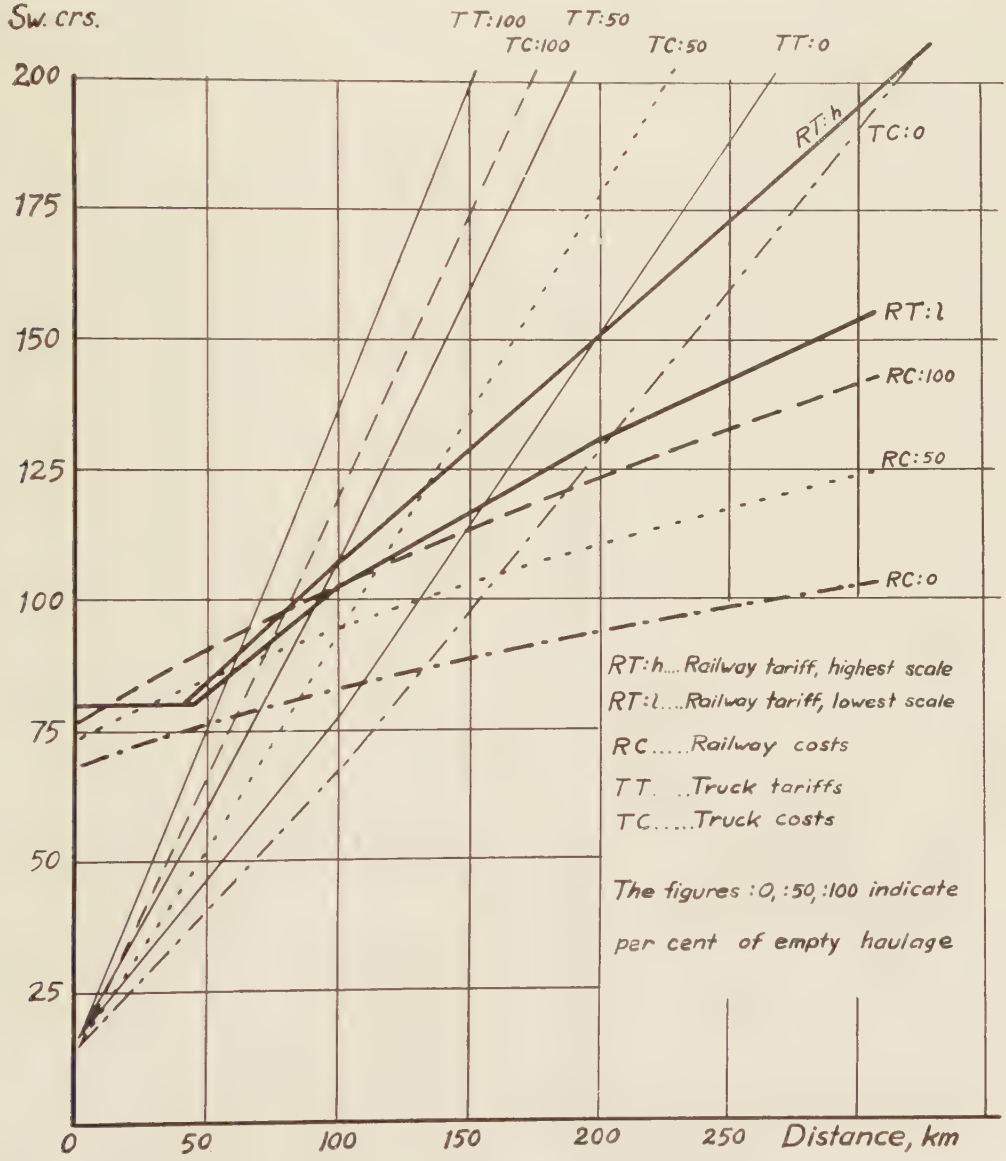


Figure 14

TRANSPORT CHARGES AND COSTS BY RAILWAY AND BY ROAD

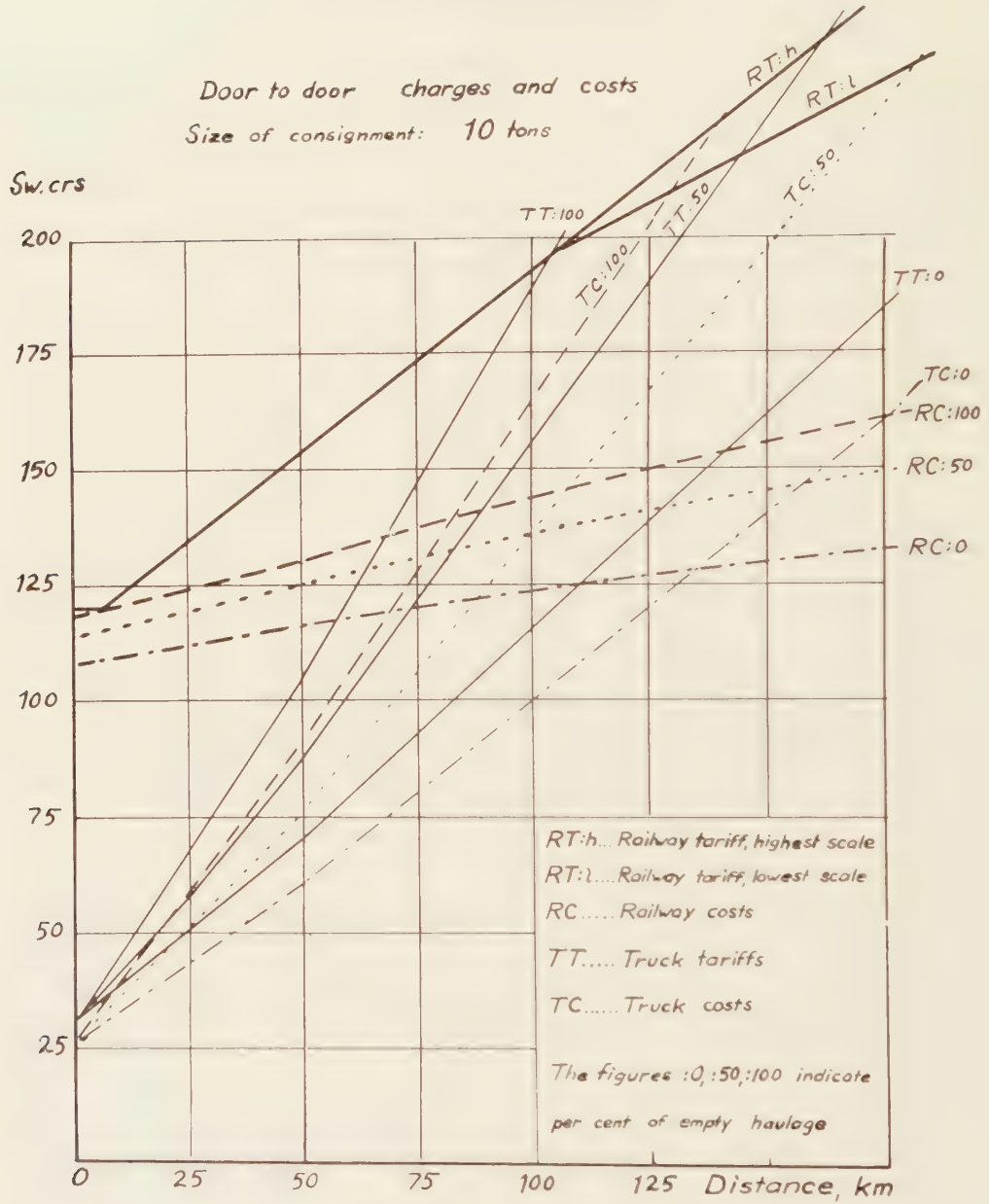


Figure 15
TRANSPORT CHARGES AND COSTS BY RAILWAY AND BY ROAD
Door-to-door charges and costs
Size of consignment : 15 tons

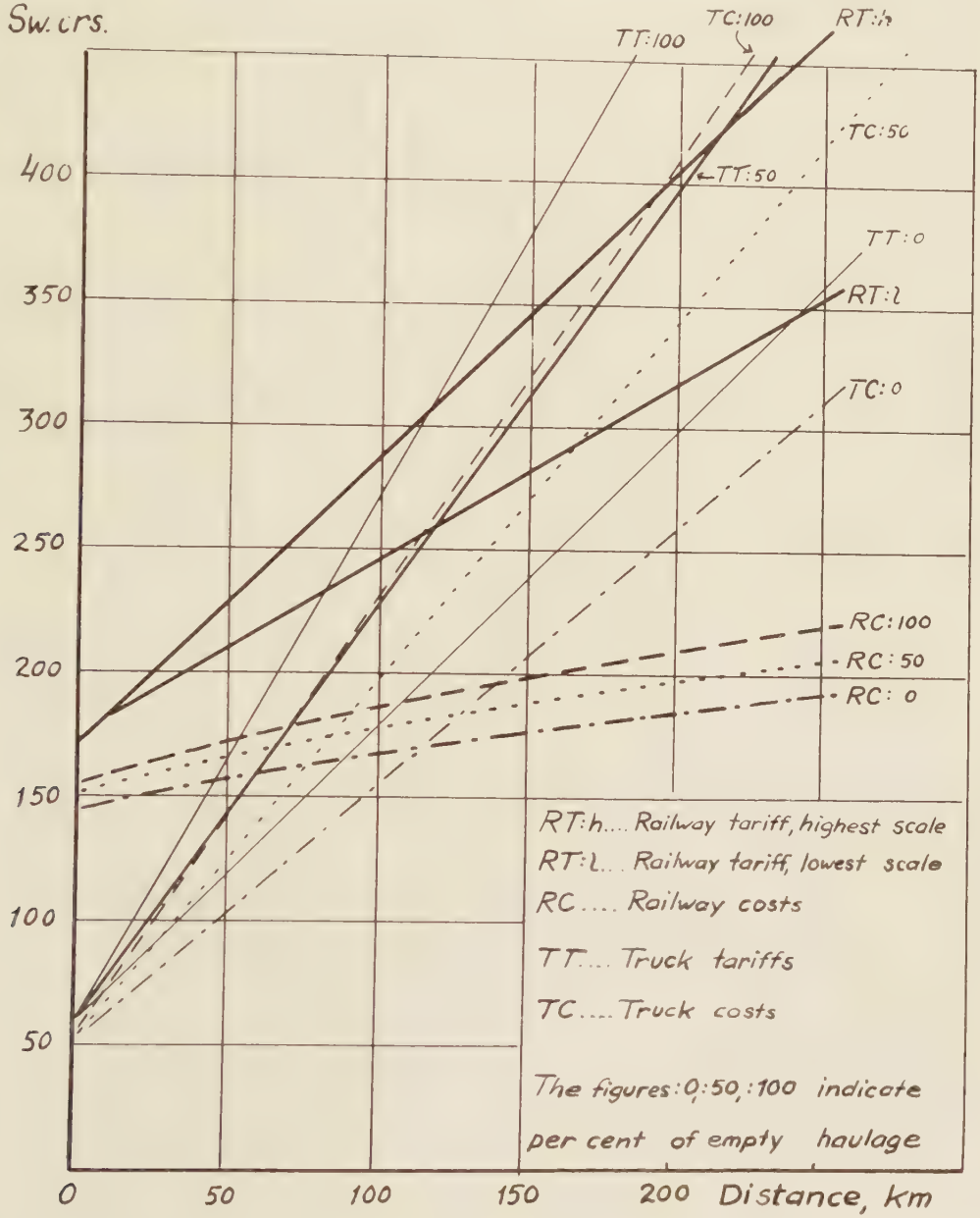
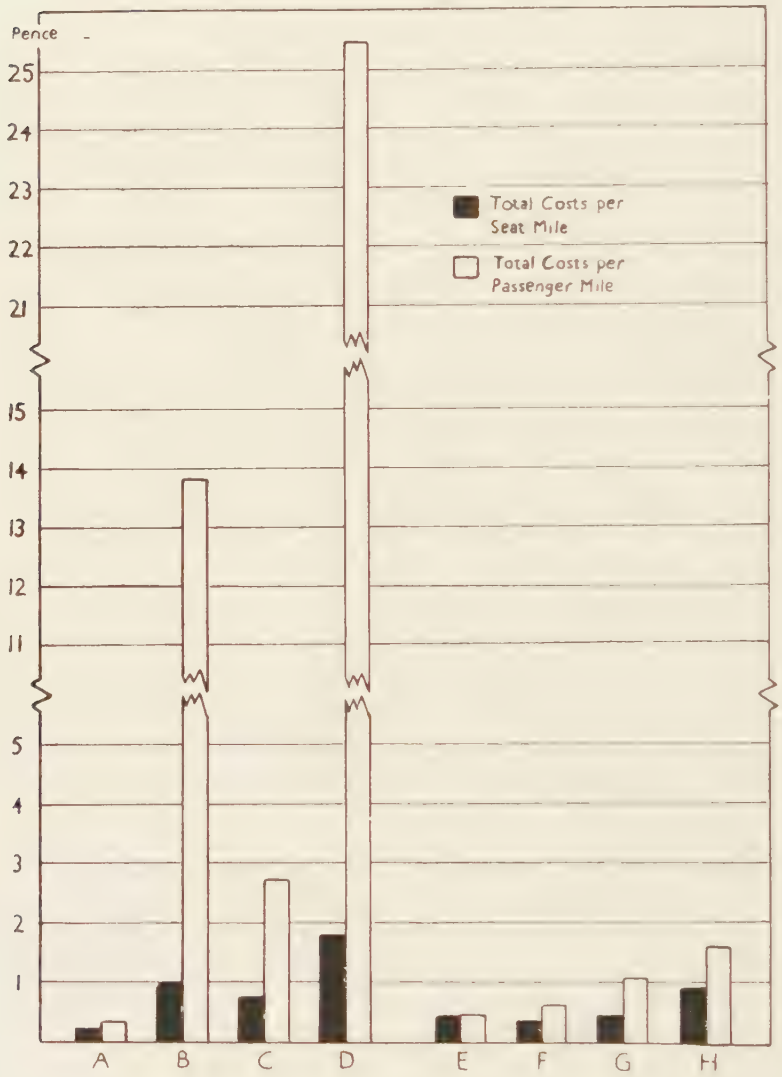


Figure 16

SAMPLE OF ROAD AND RAIL PASSENGER COSTS



RAIL

A. Main Line Express Service
B. Stopping Service on Main Line
C. Cross Country Service
D. Branch Line Service

ROAD

E. Long Distance Coach Service
F. Inter-City Service — mainly Double-deck
G. Country Service — Mixed Fleet
H. Urban Service — Single-deck

ferent assumptions, namely 0, 50, and 100 %, of empty haulage, i. e. the per cent of empty to loaded car-km respectively truck-km, or, expressed in a different way, denoting in the first two cases a return load of a length in km equal to the whole length of the original load, respectively to one third of the original load, and indicating in the last case an empty return haul of the same length as the original loaded haul.

As regards railway charges the highest (most expensive) and the lowest (cheapest) tariffs are given for carloads of 5, 10, and 15 tons with addition in actual cases of charges of collection and delivery within a zone of maximum 5 km. Road traffic usually applies « cost-plus »-pricing, i. e. addition to the costs calculated of a certain percentage for administration, risks, and profit. This method has been applied here, and further it has been assumed that truck transports in all cases are carried through from door to door.

The numerical model of the competition between railway and truck given in *Fig. 7-15* and *Table 13* confirms what has been pointed out earlier in this chapter. Railway competitive power is relatively strongest as regards station-to-station service and heavy loads, and relatively weakest as regards haulage to places not served by railway and where therefore collection and delivery charges are added. The figures and the table also show how the competitive power of truck traffic rises, especially regarding freight higher priced for railway haulage, in cases where trucks can get return loads for a longer or shorter part of their way back.

In discussions on the question of rail versus road transport, reference has often been made, since the nineteen-thirties, to the latter's concentration on the more valuable traffic, i. e. on transports of high-value goods in regular services with heavy volumes of traffic, leaving low-value goods in irregular and less-used services to the railways. Yet one major reason for this trend, which probably has been increasingly accentuated, seems to have been the existence of the railways' tariff system, based on the value of the goods carried and characterized by uniformity in space. The present historically and politically conditioned system of railway tariffs appears, therefore, to have constituted a substantial burden for the railways in their competition with road transport. Similarly, this element has probably rendered difficult a rational allocation of traffic between rail and road transport under which assignments would be executed by the service whose costs would be the lowest. All revisions in the framing of the railways' tariff policy since the late nineteen-twenties may be said to have constituted an attempt at partial abandonment of tariffs based on the value of goods and on uniformity in space, and to have aimed at adjusting tariffs more to the costs of executing transport assignments and to competition on the transport market. An even more far-reaching departure from this system, and the consistent use of tariffs based on relative costs, would probably serve substantially to increase the competitive power of the railways vis à vis road transport, at the same time creating requisites for a more rational allocation of traffic.

Finally some data will be given to illustrate cost conditions for transport of passengers by rail and by road. As has been pointed out earlier, one of the most important characteristics of transport costs is their great variability, even for journeys of the same length and in the same station relation, owing to the season of the year, or day of the week, or hour of the day, or direction of the journey, or other circumstances.

Even if we disregard these strongly varying conditions and confine ourselves to a relation of different types of average operating conditions, we shall find a considerable range of variations between the different main types of passenger traffic occurring within a railway system or a road traffic service. In the third annual report of the British Transport Commission are given a

TABLE 13.

1	Railway tariffs are cheaper than corresp. truck tariffs above the following distances in km		Railway costs are lower than corresp. truck costs above the following distances in km at an empty rail haulage of		
	Highest rail tar.	Lowest rail tar.	0 %	50 %	100 %
	2	3	4	5	6
I. — *Station-to-station transport :*					
5 tons : Empty truck haulage 0 %	38	38	34	60	82
» » » 50 %	27	27	22	32	46
» » » 100 %	20	20	16	24	30
10 tons : Empty truck haulage 0 %	95	95	2	14	24
» » » 50 %	16	16	2	9	15
» » » 100 %	7	7	1	6	10
15 tons : Empty truck haulage 0 %	0	0	0	0	0
» » » 50 %	0	0	0	0	0
» » » 100 %	0	0	0	0	0
II. — *Station-to-door transport :*					
5 tons : Empty truck haulage 0 %	153	114	86	120	149
» » » 50 %	59	53	55	71	84
» » » 100 %	37	37	38	48	55
10 tons : Empty truck haulage 0 %	540	212	75	91	107
» » » 50 %	96	96	50	59	66
» » » 100 %	60	60	37	44	50
15 tons : Empty truck haulage 0 %	240	113	43	'53	62
» » » 50 %	100	58	30	35	40
» » » 100 %	56	40	22	27	29
III. — *Door-to-door transport :*					
5 tons : Empty truck haulage 0 %	197	155	132	161	188
» » » 50 %	100	90	85	102	115
» » » 100 %	61	58	60	71	79
10 tons : Empty truck haulage 0 %	634	314	135	157	176
» » » 50 %	164	145	88	100	107
» » » 100 %	104	104	69	77	83
15 tons : Empty truck haulage 0 %	368	240	113	128	139
» » » 50 %	210	118	76	84	90
» » » 100 %	115	82	60	66	71

sample of rail and road passenger costs illustrating the kind of variations that occur in the average costs of typical passenger services, rail and road, though not of course in the fares charged, which usually tend to be standardized by distance, at least as regards railway services. *Fig. 16* shows total costs per seat-mile and per passenger-mile for main line express service, stopping service on main line, cross country service, and branch line service by railways and the costs of corresponding services by road motor traffic.

VI. Closing down of railway facilities in the process of adaptation to changing conditions.

As pointed out in previous chapters, changing conditions in economic life and heightened competition between rail and road transport after World War I, led in most countries, to a far-reaching progressive adaptation of the railways' business policy to these changed conditions. One of the chief features of this process was the effort to increase operational efficiency by rehabilitating certain sections and closing down or curtailing services on other sections, etc. The process cannot be said to have been completed when World War II broke out. During the war railways, like other transport services, were overworked, so that competition on the transport market was not so accentuated; but since the war a marked state of competition has arisen, concurrently with a progressive decline in the traffic volume of most railways in relation to the war and early post-war years. General economic conditions too are considerably changed today in relation to the pre-war years; hence an adaptation of the railways' business policy in various respects to the changed conditions is still a matter of considerable urgency.

Due to the substantially increased traffic density on the main lines in most countries, as well as the relatively high cost of labour (consequent upon improved wages and working conditions), the construction of double tracks, electrification and expanded automatization and mechanization are now more profitable than before on such lines. Indeed, rationalization investments designed to eliminate various kinds of bottlenecks are urgently required today, especially in respect of the main lines, where in most countries they have exceeded that density of traffic which may be considered economically optimal with the present installations. Moreover, in view of this heavy increase in traffic density and in labour costs, there is justification for rationalization investments envisaging heavier rails, macadam ballast, more double tracks, automatic signals, heavier locomotives, lightweight carriages to make longer trains possible, etc. For similar reasons investments designed to reduce the operating costs of terminal establishments are warranted. The operating of terminal establishments is one of the most labour-consuming branches of the railway service, and far-reaching mechanization and automatization in this field might well pay substantial dividends. Here it is a case of measures such as rational localization and planning of the various terminal establishments in relation to the structure and volume of traffic; mechanization and automatization of switching operations at the big marshalling yards; mechanization of freight handling at the big freight houses, etc.

On the lesser used branch lines the relatively high labour costs and higher prices of coal have served to impair their economic position still further. Moreover, in most countries increased motorization of such lines — which in many cases would have improved their economic position — has not been possible owing to lack of funds.

Broadly speaking, the substantial rise in labour costs in relation to the pre-war years has made such transport assignments of the railways as require a comparatively large proportion of manual labour (merchandise, passenger traffic, etc.) less profitable. Yet at the same time, investments on rationalization in such fields have become relatively more lucrative than before.

General supervision of the structure of production and of service to the public must aim at determining which branches of the activity are unprofitable and by what means their profitability, and hence the railway company's economic position as a whole, could be improved. This aim might be briefly described as the accomplishment of a higher net revenue by effectivizing production and sales activities and concentrating them to a smaller number of more profitable sites of production, and more profitable categories of transport assignments, respectively. This supervision should embrace the following branches of activity.

1) The various *lines* in the network. Here it may be a question of simplifying operations, or of partial or total closing down of the least profitable lines and the introduction of bus and truck services to complement or replace them.

2) The various *sites of production,* such as stations and other traffic establishments, engineering plants, stores, etc. Concentration of activities, or the total or partial closing down of certain centres of production, may often serve to improve the economic position as a whole.

3) The various *trains* in passenger and freight services. Modified train schedules, introduction of new train services, withdrawal of existing trains or changes in their length, etc., may also bring about a better economic position.

4) The various *cars* in passenger and freight services. The economic position may be improved, similarly, by changes in the types of cars, the introduction or withdrawal of through sleeping or passenger cars and through merchandise cars.

5) Needless to say, not all branches of traffic are equally remunerative for the railway company. The profitability may vary considerably for large and small consignments of merchandise and freight, and for irregular and regular assignments in freight traffic and journeys in passenger traffic. Likewise, journeys in passenger traffic and transports in freight traffic which occur during peak traffic periods, are naturally less profitable than those which occur during slack periods. By revising rate policy and undertaking changes in train schedules and types of cars, etc., it will often be possible to make different branches of passenger and freight services more profitable and hence improve the economic position of the company.

In conjunction with general supervision as outlined above, it is also important that matters relating to the standard of transport services be observed, so as to avoid providing a higher standard with regard to speed, etc. than is consistent, economically, with what the relevant transport user is prepared to pay. Within certain limits it is here a choice either of higher standard and higher prices or lower standard and lower prices. With regard to certain types of transport the user's demand for a high standard will determine his choice of transport facilities, while with regard to others the lower prices will be the determining factor. However, general considerations of good will, especially in passenger traffic, also determine in some measure the standard of transport offered by a railway. For instance, according to American experience the existence of high-class passenger services, with modern engines and cars and high speeds, also has some influence on the demand for freight traffic.

Both in general supervision of business policy as outlined above and in the more continuous control of business policy, adequate knowledge of expenditure and receipts, and the possibility of putting this knowledge into practice, are required. This in turn calls for various kinds of estimates of expenditure and receipts, partly for rationalization and the checking of operations, partly for the fixing of rates. Such calculations are necessary not only for the rational management of railways, but also for an intelligent policy designed to protect the railways' interests in relation to such institutions, etc. as influence the

external conditions on which its economic life is based (government, parliament, economic associations of various types, press, radio, etc.).

A. — *Railway Systems — Conglomerations of lines and stations of varying profitability.*

A railway system is composed of a number of individual lines. We may distinguish between primary lines — the big main lines of interregional importance, along which the dense traffic flows; secondary lines, which are largely of regional importance and which carry traffic of lesser density; and tertiary lines, which are often merely of local importance, but which may also have some significance for regional or interregional traffic as feeders to primary or secondary lines. The traffic density varies considerably both between and within these three groups. In most countries railway traffic is largely concentrated to main lines. As will be seen from Fig. 1, this is the case e. g. in Sweden, where 75 % of the traffic is carried by one third of the mileage, 20 % by another third, and the remaining 5 % by the rest of the mileage. Before the war, 80 % of rail traffic in Italy was concentrated to one third of the system, 15 % to another third, and 5 % to the remainder. The relative profitability of different lines varies, of course, according to the traffic density and the economic structure and seasonal distribution of the traffic. Lines with very heavy traffic and favourable operating conditions may be exceedingly profitable, whereas lines with low volumes of traffic and unfavourable operating conditions may entail a net loss to the railway system. Hence the economy of the railway system as a whole will be dependent on that system's composition with respect to individual lines of varying profitability.

The lines carrying small volumes of traffic constitute a long-standing problem in the sphere of railway economy which has been under discussion since the end of the nineteenth century, when extensive building of branch lines occurred in most countries. The discussion on « the branch line » problem, « the weak and strong road » problem, has since come into the foreground on various occasions, particularly in situations where the economic position of the railways has been unfavourable.

In many countries, above all those in which railway construction came about on private initiative, branch-line construction has probably been determined in great part by motives of business economy. That the economic significance and the economic problem of these branch lines were often clearly realized is evident, e. g. from the following statement by Wellington in his classical « Railway Location », which puts the whole problem in an admirably lucid manner.

« That branches are in the main profitable investments is evident from their very rapid rate of increase, which is largest, up to a certain point at least, on the most prosperous lines. That they are rarely very profitable when considered by themselves, and apart from the main line, and as a rule do little more than pay operating expenses, is abundantly shown by the reports of almost every line which has branches and reports their traffic in detail. This fact is so clear and so generally admitted, that it hardly needs statistics to prove it. As a rule, the earnings per mile of branches range only from a *fifth* to a *tenth* of the earnings of the main stems.

Neither is it to be wondered at that the seeking for them (branch lines) is often overdone, so that the branches become a burden which threatens to swamp the main line, and often does so. For there is this to be said against branches : Their traffic is usually thin, while they cost as much or more to build and not much less to keep up than the main line. Therefore it is easy to lose all that is gained on the main line by the extra cost of handling the traffic on branches and paying their rentals; although it still remains universally true that branches are far more profitable than

appears on the face of their returns, separately considered. »

WELLINGTON illustrates the economic reason for the continued and rapid building of branches in spite of their apparent unproductiveness by pointing out that they contribute traffic to the main line which, as it is merely an increment, costs always comparatively little to move, and often nothing at all. The company, therefore, receives from its contributed traffic rates for a haul of perhaps 500 miles at a cost for hauling due to only 100 or 200 miles. Rudely speaking, if we call the average cost per ton or passenger-mile 100, we may say :

« Average cost per unit of traffic .	100
Extra passengers, singly, cost . . .	0 +
Extra passengers, in car-load cost .	5 to 30
Extra passengers, in train-loads cost	50
Extra freight in small lots costs often in both directions and usually in one direction . . .	0 +
Extra freight in car-loads	5 to 20
Extra freight in train-loads (and all car-loads must ordinarily be considered to be made up into extra trains in the direction of heaviest traffic) not over	60

« Not infrequently, when a large part of the traffic of a branch goes over the main line in the direction of favoring grades it is handled over the main line at no appreciable extra cost by simply filling up trains, and the branch is then enormously profitable. To these direct and evident advantages from a branch is to be added the vivifying effect of increasing the tributary population, the prosperity of the line increasing in something like the square of the tributary population. »

The economic policy of a railway company usually aims at covering the costs for the railway system as a whole. The tariffs applied by railways are generally uniform in respect of the entire system; they take no account of differences in transport costs on different lines. Hence a substantial economic equalization occurs between different lines, whereby losses on the light traffic lines are compensated by profits on the others. The entire economic position of a railway system is thus largely dependent on the relative proportions of light and heavy traffic lines and systems. Those lines that are run at a loss constitute a substantial economic burden both to the railways and to the community. Hence rationalization of the operating of these unprofitable lines is a matter of some urgency, either within the existing framework of operations or in the form of a complete or partial changeover to road traffic when the latter proves less costly and capable of providing the same standard of transport facilities for the population along the lines in question.

In a large railway system where the aim of business policy usually is that total income from the traffic shall balance total expenditure, and where uniform tariffs apply to traffic from, to, or via practically all branch lines, it is not always possible for lines of low traffic density, and especially new branch lines, to pay their way. The resulting position is that whilst lines of high traffic density (main lines) may earn profits, secondary lines normally just about meet expenses, but branch lines as a class incur losses. Statistics are not readily available to indicate definitely which lines are economically justified and which are not, but since a national railway system also must take into consideration the economic development of the country, it is in most countries not the policy to close down railway lines solely on the score of economic justification.

In such large railway systems, different services and different methods of transport will show varying degrees of profitability and will be unable to contribute at a uniform rate to the common and constant expenses of the railway enterprises. It is generally not possible in such systems to avoid the provision of some services which are unprofitable even perhaps in the sense that they do not support their own marginal costs of operation. As said by the

British Transport Commission in its first annual report, there is nothing new in the acceptance of this principle. Within the main-line railway system itself there are areas of the country, and certain branch lines and perhaps certain traffics, which would not meet the test of being self-supporting in either sense. Again, as in the case of Britain, long before the policy of nationalization or socialization was adopted in regard to passenger transport in London, the private companies previously responsible had been forced to make use of the high earnings of surface transport to meet the cost of providing underground services necessary to deal with traffic which would not otherwise be handled. The extent and the degree of the « collective risk-equalization » in a large railway system — that is, the degree to which one form of transport or one service can and should be called upon to support another — will vary from time to time but, especially for State railway system, a bold application of the principle within reasonable limits may often be necessary to establish an adequate system of facilities for the country as a whole.

In consequence of the general economic and the technical trend on the railways, and of competition from road transport, there occurred a progressive concentration of traffic to the more profitable lines with large volumes of through traffic, whereas the less profitable and shorter lines decreased in significance. For similar reasons a similar concentration occurred with respect to stations and other traffic collecting and dispersing points, where the traffic today is largely concentrated to the largest stations. This tendency to concentrate to major stations is usually greater for passenger and merchandise traffic than for carload traffic.

Table 14 shows the percentage distribu-

TABLE 14.

Percentage distribution of certain traffic factors among stations of different sizes on the Swedish State Railways in 1944.

	Large stations	Medium sized stations	Small stations	Total
	Per cent			
Number of stations	2	26	72	100
Staff number	55	36	9	100
Staff costs	57	36	7	100
Traffic receipts collected	55	37	8	100
Number of tickets sold	45	43	12	100
Number of shipments of luggage	44	45	11	100
Number of shipments of parcel and fast merchandise freight	54	38	8	100
regular merchandise freight	46	45	9	100
carload freight	39	48	13	100

tion of certain traffic factors among stations of different sizes on the Swedish State Railways in 1944.

The heavy traffic on the main lines and at the major stations has made it possible to specialize and mechanize operations and to raise the standard of transport in far greater measure than on the less used lines. From the standpoint both of costs and of transport standard, the first-named lines and stations thus enjoy far more favourable conditions than the last-named. Hence users of the less profitable lines have a relatively poorer standard of transport than those using the main lines. Due to these favourable operating conditions on the main lines it has paid to transfer as much of the traffic as possible from the less used lines, even if this has entailed considerable lengthening of the transport routes. The difference in marginal transport costs between main branch lines has already been illustrated in Fig. 6. Through traffic has therefore been diverted on a considerable scale from the less used to the main lines, wherever such has been possible. Such measures have been of benefit both to the railways themselves and to their users.

Those structural changes which have occurred in the demand for transport services and in transport technic — the effects of which on rail traffic have been illustrated in previous chapters — necessitate various adaptation measures respecting the number of lines and stations, etc. in the railway network, if the aim is to bring about as rational a transport system as possible.

As regards regions with not unduly dense traffic, the transport requirements can probably be met in the best and cheapest way by a relatively open network of railways, maintained at a comparatively high technical and operational standard. The « mesh » of this network will be dependent, among other things, on the proportions of local, regional, and interregional traffic, and on the extent to which it is necessary or profitable to retain local traffic in the network. From the economic point of view this local traffic should mainly consist of road transport, which serves too as a means of collection and dispersal for the railways and which implements the railway network.

Due to the more efficient collection and dispersal of traffic to and from railway stations that has now been effected with the advent of road traffic, the economically optimal distance between railway stations has usually increased to a high degree. This has been manifested in a more marked concentration of traffic to a smaller number of stations. As mentioned previously, the mounting urbanization of economic life, etc. has contributed to this tendency to concentrate traffic.

In some cases an adaptation of the railway network in above respects to the changed conditions would probably presuppose the closing down or stripping of certain existent lines or stations, and the rehabilitation and refitting of other lines and stations. In certain cases the establishment of new lines and new stations (for collection or dispersal of traffic) or new switching yards, etc. may be justified. Use of road traffic coordinated with the railways as a supplement to and substitute for rail traffic might well reduce operating costs for the railways and ensure a higher transport standard for the people, notably in sparsely populated regions, due to the greater extent of the road network and the smaller operating units in road transport.

B. — *Reasons for closing down of railway facilities.*

The closing down of a railway line may come into question either because the demand which it is designed to meet subsides or disappears, or because that demand is largely met by other means of transport.

A demand for transport services may totally disappear, for example, if a source of raw materials for the exploitation of which the railway has been built becomes exhausted or for some other reason ceases to be utilized. Purely from the standpoint

of business economy, the question of closing down the line presents no problems in such cases. From this point of view the closing down should occur when the demand definitely disappears.

But not even in these clear-cut cases are the above standpoints bound to be decisive. In the cases of State railways in particular, other considerations, such as social, political, or military, or hopes of the emergence of a new demand and the taking of measures accordingly, may prevent, or at all events delay and limit, a closing down that is justified purely from the economic standpoint.

Partial subsidence of the demand for transport facilities may follow e. g. structural changes in the economic life of the region which a railway has been built to serve. The moving of industries and commercial centres as a result of concentration, or the influence of other localization factors than the original ones, may bring about such a subsidence or a decisive change in the nature of the demand. Closing down measures for the reasons outlined above must usually have to take into account the possibilities of meeting the persisting demand for transport services with other means of transportation. Hence they present, by and large, the same practical and economic problems as those cases in which closing down comes into question because of a decline in the demand consequent upon competition from other transport services.

Such competition has undoubtedly been the chief of those factors which have reduced the demand to such an extent, on certain sections of railway, that their closing down has come into question. Of the competitive transport services, airways can usually be disregarded in this connection. Competition from airways mainly concerns traffic on regular long-distance routes, and its effects are usually limited, at all events in Europe, to a very circumscribed part of the traffic; consequently it seldom becomes so extensive as to require any closing down or curtailment of railway operations. However, in U. S. A. and in intercontinental traffic the rapid post-war development of airways has had considerable repercussions on the railways' long-distance passenger services, particularly since the introduction of air coaches and tourist class passages. To all appearances, the technical requisites for mass transportation of passengers and freight by air already exist or soon will exist, as is evidenced, for instance, by the air lift to Berlin and by other achievements in military air transportation. Yet, some considerable time is likely to elapse before the airways can establish the economic requisites for major competition with railways.

Competition from maritime transport services can probably be disregarded in this connection though cases naturally occur in which improved communications by waterways and improved port facilities have contributed to the loss of traffic on the railways. The commonest instances of declines in the demand for railway service as a result of measures from maritime traffic are probably not to be regarded as the results of competition; rather they are associated with structural changes in maritime traffic, generally in the form of increasing concentration to the big ports. In this way some railways which were originally designed to serve the smaller ports have had their traffic volumes reduced. Yet in certain special cases, for example in U. S. A. the spirited opposition of railway companies to certain canal projects financed by public funds demonstrates that competition from maritime traffic may entail a substantial fall in the traffic volume of railways. This applies in particular to bulk freights such as coal, iron, etc. However, in most cases of competition between maritime traffic and railways, the latter should be capable of retaining their position, e. g. on account of the importance of speed.

Thus it is primarily the competition from road transport that may reduce a railway's volume of traffic to such an extent

as to necessitate total or partial closing down of traffic on certain lines.

But road transport has not had this negative significance alone; in all countries it has come into use as an important supplement to and substitute for railway operations. The railways' use of motor road traffic as an instrument for rationalizing railway operations has often been delayed or rendered impossible, however, by existing laws prohibiting them from acquiring licences for the use of trucks, etc. Moreover, railways have often been compelled for social or other reasons to forego such measures as might have been desirable from the standpoint of business economy. Since the early nineteen-forties road transport, competing with railways, has taken over such a large proportion of the traffic volume in certain sparsely populated regions in several countries that the total abandonment of operations on certain lesser used lines would have been economically justified. But since such measures would have required extensions of the road network or the acquisition of further vehicles — which under the prevailing economic conditions was usually impracticable — the responsible authorities usually refused to sanction the closing down of such lesser used lines. Total closing down and a transition to road transportation might also have been prevented or rendered difficult by opposition from such customers as have had typical railway freight and who have built up the whole of their activities accordingly.

The various measures that might come into question when a railway line has lost all or part of its importance, yet still must face a certain demand and therefore take into account the possibilities of executing transport assignments by other means, are as follows.

1. Total and definitive closing down.

2. Partial closing down :

a) with respect to types of traffic;

b) with respect to time;

c) with respect to the magnitude and organization of the traffic system.

In certain cases various combinations of the above measures may come into question.

Partial closing down with respect to types of traffic may involve the withdrawal of all passenger or all freight traffic, or the transference e.g. of local passenger or freight traffic to other means of transportation.

Partial closing down with respect to time may involve the total withdrawal of all traffic during certain periods when the demand either abates or disappears on a seasonal basis or due to slumps. It may also involve retention of freight traffic but temporary suspension of passenger traffic.

Partial closing down with respect to the magnitude and organization of the traffic system may involve, for instance, the closing of certain stations and the concentration of traffic to a few centres of distribution or collection. It may also imply the withdrawal of traffic in certain limited areas, e. g. factory or quayside tracks belonging to a certain line.

The adaptation of a light traffic railway line to a progressively diminishing volume of traffic — a process that was common in most railway countries during the inter-war years — is generally characterized by a progressive reduction of operational and service standards, approximately as follows.

Continuous decrease in service, by reducing the number of trains, employing combined passenger and freight trains, maintaining traffic only on certain days, closing down certain stations, withdrawing either passenger traffic or merchandise traffic, and lastly freight traffic in carloads. In certain cases, however, the passenger traffic will be that which is retained the longest, particularly in surburban areas. Concurrently with these progressive reductions in service, various measures to economize are carried through, such as the reduction of train crews, simplification of rules for

train operations, less strict maintenance of the permanent way, locomotives, carriages, and other installations, which are maintained only insofar as is essential for safe transportation. Although this progressive reduction of service primarily aims at cheaper operation, it usually results in a fall not only of expenditure but also of income. Deterioration of railway service will often result in traffic going over to other means of transportation, notably road transport.

As long as a railway line can be operated with relatively low costs for maintenance and renewals and covers its variable (out-of-pocket) cost, the need of closing down may often be not so urgent. At the time, however, when it is necessary to spend maintenance expenses in order to secure sufficient traffic safety or when renewal of its tracks is due, the line will usually be closed down.

The primary reason for closing down a railway line is the conviction that the existing mode of operating the line is unprofitable and a financial burden to the railway system. A detailed study of the reasons given for the closing down of railway lines in U. S. A. during the period 1920-1932 has been made by R. E. Westmeyer. This study, which comprised 565 cases involving 7 997 miles of line, shows that the most important factor causing unprofitability of branch lines during this period was exhaustion of natural resources, which accounted for 33.8 % of the cases, representing 27.1 % of the railway mileage closed. The second important factor was motor competition, which alone or in combination with other factors made up about 20 % of the cases and about 30 % of the closed railway mileage.

So far as the writer is aware, permission of the government or a special governmental agency is required in all countries before a railway company can close down any part of its railway system. It is apparently a general rule among railway companies that, before applying to the appropriate governmental authority for permission to close down e. g. a certain branch line which has become unprofitable, whether due to the development of road transport or any other cause, they first make every effort to increase the traffic receipts and reduce the working expenses of the branch line. If these efforts fail to make the branch line pay, and the closing down of the branch is estimated to result in a net financial gain to the system, i. e. the savings in expenditure are estimated to be greater than the losses in receipts of the branch and of the incidental receipts of the remaining parts of the system, the railway Administration, after taking into account the transport needs of the area served by the branch line and the possibilities of serving the area by other transport means, may ask the government body to sanction the closing down of the branch line.

If the government regulatory body, for political, military, or other reasons, should decide not to allow the closing down of a line, even if such closing down indisputably would prove to be profitable, the deficit on operation of the line must usually be covered by the profits on other lines (the « collective risk-equalization » of the lines of the system). This naturally implies that higher rates and fares than would otherwise be necessary must be paid by the users of other parts of the system. With regard to State railways working with a deficit for the whole system, the State, as proprietor of the system, must cover that deficit out of the general revenue from taxes, etc. In some cases, moreover, the State subsidizes transport users in branch-line areas or in certain social categories, etc., by compensating the railway companies for losses incurred by having to operate such unprofitable branch lines or having to apply higher operational standards or lower tariffs than are consistent with business economy. In Sweden, for instance, the Minister of Transport in 1948 expressed the view in principle that « the costs of economically unjustified reductions in passenger and freight rates should not burden the State Railways », but that the

railways should be compensated by the State for such reductions, introduced with the aim of subsidizing, for example, a certain region or a certain branch of industry.

To illustrate some of the problems that confront regulating authorities in considering the closing down of a branch line, the following statement, made by the U. S. Interstate Commerce Commission in 1925 in connection with a proposal to close down some branch lines of the Boston and Maine Railroad, may be cited :

« ... This railroad and the people it serves are peculiarly interdependent and in these abandonment cases there must be kept constantly in view the necessity of the preservation of as much as possible of the present mileage in the service of the greatest number of the people. The evidence seems to be conclusive that not a few of the lines which it is now proposed to abandon should never have been built. Under present conditions they would not be built. At the time of their projection as independent enterprises it seems to have been understood that some of them were built for purely competitive or strategic reasons. »

« But irrespective of the origin of an existing line, people gather about it and create for themselves an interest in and a dependence upon it. Under these circumstances abandonment brings about the kind of hardships with which it is so difficult to deal. The sufferers in such cases have no redress against those guilty of the original error, nor were they responsible for that error. In some of the instant cases the extent of hardship which would probably follow abandonment would be very great, while in other cases it would be negligible... The serious and difficult problem is how to sustain both the railroad system and New England territory as a whole without undue hardship on particular local territories. Benefits to the system of particular abandonments must be weighed against the inconveniences and losses which those abandonments will inflict upon the communities immediately affected. Benefits to particular communities of continued operation must be weighed against the burdens and retarding effect of such operation upon the development of the Boston and Maine system as a whole... »

Whereas regulating authorities, when considering closing down proposals, previously took into account perhaps above all the needs of transport services in regions with unprofitable branch lines, they seem today — now that satisfactory road transport facilities can often be arranged in such sparsely populated regions — to be paying increasing attention to the economic position of the railways; at the same time stressing the necessity for the people of the relevant regions to use the line in question if they wish it to be retained.

The U. S. Interstate Commerce Commission in 1931 very clearly stated its view that local communities had to face the consequences of their choice of transport facilities, and issued a long-term « warning » to communities which gave their patronage to trucks but still desired the railway :

« That every community is entitled to use those means of transportation which it prefers cannot properly be questioned by anyone, we think. Those who prefer a steam railroad and can support it have a right to their choice. Those who prefer a line of motor trucks have the same right. Similarly, those who prefer still other forms of transportation have also this right. However, when a community has at its disposal, as many or most communities have, several means of transportation and it has exercised its choice in the form of patronage, it must realize that those means of transportation which its choice has eliminated from patronage may not be able to continue to exist without such patronage and that abandonment must follow as a last resort. A community which can support every known means of transportation is unquestionably entitled to them all; but a community which can support only one cannot insist upon the retention of two if the patronage accorded

to the least favored one is not sufficient to enable it to live. A railroad company whose resources have been exhausted due to loss of traffic to other agencies cannot continue to serve. Operating expenses cannot be paid out of an empty pocket. »

Transportation policy, as declared by governments in most countries of the world, usually envisages the establishment of an adequate, efficient, and properly integrated transport system comprising, among other things, the closing down of such transport facilities which have lost most of their economic utility, and elimination of wasteful duplication of facilities maintained for competitive or other purposes. In Sweden, for example, Parliament in 1932 made the following statement of policy :

« Since transport facilities are designed to serve the community as a whole and must not be regarded as an end in themselves, it is the opinion of Parliament that State transportation policy should aim at furthering the development of efficient means of communication that will benefit the community. Insofar as a means of communication, due to technical advances, has lost its significance so that its purpose can better be fulfilled by another means of communication, measures should not be taken to prolong its life span. Yet, at the same time it should be borne in mind that in exceptional cases it might lie in the public or other interests to subsidize from public funds such transport enterprises as would otherwise be economically incapable of continuing their activities. »

« In this connection Parliament for its part considers that, just as obstacles should not be raised to the free development of road transport — insofar as it is carried on under sound economic conditions — so should railway enterprises that no longer meet a real public need be barred from maintenance through subsidies from public funds or through the suppression of competing transport services. »

C. — *How is the unprofitability of railway facilities determined? Calculation problems.*

Total or partial closing down of a railway facility is profitable for the railway enterprise if its net receipts are thereby increased. The deliberations of a railway management on questions relating to the closing down of railway facilities must be based on calculations subject to the same principles as those applied in other measures affecting business policy which were exhaustively discussed at the 15th Session of the International Railway Congress Association in Rome in 1950 (Question X).

In the author's Rome report of 1950 on this question it was stressed that the railway enterprise, for a rational shaping of its business policy, needed a flexible type of calculation, called profitability estimations or alternative budgets, which consisted in estimating what changes a certain business plan could be expected to cause in the expenses, revenues, and net-revenues of the enterprise in comparison to the position that would arise if the plan in question was not executed or a certain other plan was chosen. By such profitability estimations the net-value as well as the relative value for the enterprise of each of the possible business plans can be obtained.

Provided the aim of the activity is to obtain a maximum net-revenue, the general profitability criterion of different business plans can be stated in the following way. Each business-political measure (changes in the size of plants, closing down of a station or a branch line, substitution of motor truck traffic for rail traffic on a certain branch line, construction of a new branch line, etc.) is profitable for the enterprise as a whole if there is an increase of the total net-revenues of the enterprise, caused by the measure in question.

If it shall be profitable for the railway to maintain a branch line (station), it is necessary that the substractive revenues which the enterprise would lose if the

branch in question were discontinued be greater than the subtractive costs that the enterprise would save by such a measure. If, on the other hand, the aim is to construct a new branch line, this will only be profitable if the additional revenues obtained by the enterprise are greater than the additional costs caused by this new branch line.

In general the enterprise has, in a certain situation, the possibility to choose between several different business plans, not one alone, but several of which may be profitable for the enterprise in the sense mentioned above. The most profitable of the existing alternatives is of course the one that brings the greatest increase of net-revenues for the enterprise as a whole.

Even if, in case of a « closing-down calculation » for a certain railway facility, a line or a station, it should turn out that the subtractive costs are greater than the subtractive revenues — i. e. one would save more in costs than one would lose in revenues by closing down the line or station in question — it does not necessarily follow that this plan would be the most profitable for the enterprise. Provided only that the costs vary in direct proportion to the changes in the amount of traffic of the line or station (« proportional costs »), the deficit on the present amount of traffic will become greater than in the case of a total closing of the traffic. If, on the other hand, the relative change of the costs is smaller than the relative change of the amount of traffic, i. e. the costs are *degressive*, the deficit on the present amount of traffic may, of course, as in the case of proportional costs, be greater than in the case of a total closing down of the traffic; but as the costs of an increase of the traffic usually increase relatively slower than the traffic, the deficit on the present amount of traffic will diminish when traffic increases, if it is possible to obtain such an increase of traffic without, or with not too much, changing of (i. e. lowering) the tariffs. In the case of a sufficiently great increase of traffic the present loss could possibly, because of the lowering of the costs, be expected to turn into a surplus on the line or station in question. From a business-economical point of view it thus depends on the circumstances in the individual case whether it is more profitable to close entirely or partly or to increase the production. If, finally, the costs should be *progressive*, i. e. increase or decrease relatively faster than the traffic, the loss would diminish provided the traffic was reduced and, in the case of a sufficiently great reduction of traffic, would probably turn into a surplus. In this case, therefore, it will be most profitable to reduce the traffic somewhat, but not to withdraw it completely.

The following factors influence the volume of receipts lost to the enterprise if a certain closing down proposal should be adopted :

1. The probable future traffic development at various possible tariff levels on the line or at the station that may be totally or partially closed down;

2. The probable volume of that traffic which, in the event of a closing down, would go over to the remainder of the company's lines or stations, and that part which would be totally lost to the company.

In evaluating the traffic trend in each of these cases, one must naturally take into account the development of competing transport services and possible changes in the localization of industry in the relevant region which might serve either to increase or decrease the volume of traffic; as well as future changes in the structure and localization of consumption, and the technical trend both in the sphere of transport and in production and trade.

An estimate of the expenditure associated with these two potential factors will involve appreciable difficulties and elements of uncertainty. In the first place, it is often difficult to assess the volume of traffic that will be lost to the company and the proportion of traffic which in any

case will be taken over by the remaining lines; and secondly it may be difficult to envisage the mode of organizing transport operations in such a contingency.

Such calculations will naturally be approximate (they might be likened to intelligent guesswork); yet practical traffic and operational experience should make possible a fairly accurate appraisal of the way in which the economic position would be influenced by different closing down measures.

Most railways have at some time employed a system of *post-calculation* of receipts and expenditure and of « the economic result » for different lines.

The Swedish State Railways made such annual reports of results almost from the advent of the State railways network up to 1928, in which constructional costs, gross receipts, expenditure, net receipts, and net receipts in percentage of constructional costs were given in respect of different lines. *Table 15* shows the main results of the last more complete line statistics, which related to the year 1926.

With regard to the purpose and the advantages of this system, it was pointed out in 1912, when the publication of these calculations was proposed, that it appeared « to be consistent with the purpose of the tables to compute the profitability separately for the different departments of a business enterprise. Government and Parliament should be keenly interested in knowing the profitability of various branches of a business. If any particular branch should be found to give a poor yield or none at all, or perhaps a loss, then Government and Parliament should consider whether other reasons existed for its maintenance; for instance, the need of railways in certain places if they are to develop; and it would then also be possible to consider whether provision should be made in the budget for the said non-commercial purposes, so that a wrong impression would not be gained of the profitability of the business enterprise through the use of such funds for activities which from the purely commercial standpoint are unjustified ».

This accounting system required a considerable expenditure of labour, and the practice was discontinued in connection with the various economization measures that were taken in the nineteen-twenties and which affected the statistical work of the State Railways.

In the initial appraisal of various railway problems relating to economy and policy, considerable value attaches to reports on receipts and expenditure on different lines. Such accounts may be important in appraising such questions as the total or partial closing down of traffic on lesser used lines; raising of standards with respect to time schedules and transport plans on different lines; widening of narrow-gauge lines to normal gauge; the effects of the acquisition of privately owned railways, etc., etc. They may also be of practical significance in the current work of the railways by affording the management and regional supervisors some basis for checking costs and operational efficiency in general. Usually it has been fully realized that manifold economic-statistical difficulties — above all with regard to the allocation of receipts and expenditure which to a great extent are common to several lines or to the entire network — will be encountered in seeking to produce separate accounts for different lines, and that each such account must inevitably be in some measure approximate. This notwithstanding, separate accounts of this kind must be ascribed some importance as general pointers to the relative profitability of the different lines, and in the checking of costs and efficiency.

However, where it is a case, in practical business policy, of choosing between different modes of procedure, post-calculations of the above nature cannot provide sufficient guidance for a choice that will be rational from the standpoint of business economy. To throw light on the business-economic consequences, and to facilitate the choice, of various available modes of

TABLE 15.

Surplus and deficit calculations of different lines.

LINE	Average construction cost (1)	Gross operating revenues	Operating expenses (2)	Net revenue (+) or loss (—)	Net revenue in per cent of construction cost
	Million crowns	Thousand crowns			
1. Stockholm-Göteborg incl. branch lines	179.6	36 338	27 878	+ 8 460	+ 4.71
2. Järna - Malmö and Katrineholm - Norrköping	153.1	39 662	26 225	+ 13 438	+ 8.78
3. Göteborg-Malmö-Trelleborg incl. branch lines	66.1	17 158	15 450	+ 1 708	+ 2.58
4. Falköping-Nässjö	15.3	3 740	2 963	+ 777	+ 5.09
5. Laxå - Charlottenberg incl. branch lines	31.4	5 663	5 211	+ 452	+ 1.44
6. Krylbo-Mjölby incl. branch lines	50.6	9 384	8 868	+ 516	+ 1.02
7. Skövde-Karlsborg	3.2	343	462	— 119	— 3.73
8. Göteborg-Strömstad	25.3	2 528	2 674	— 146	— 6.58
9. Kristinehamn - Brunflo incl. branch lines	63.6	4 149	6 452	— 2 303	— 3.62
10. Stockholm-Bräcke incl. branch lines.	138.4	32 034	25 098	+ 6 936	+ 5.01
11. Bräcke-Storlien, Östersund-Hoting.	40.1	4 779	5 067	— 288	— 0.72
12. Bräcke-Boden incl. branch lines and Forsmo-Hoting-Storuman	134.6	11 092	13 811	— 2 719	— 2.02
13. Boden-Haparanda, Gällivare-Porjus	25.8	810	1 926	— 1 116	— 4.33
14. Luleå-Riksgränsen	121.9	21 353	13 988	+ 7 365	+ 6.04
15. Trelleborg-Sassnitz (ferry-boat)	5.8	1 800	1 641	+ 159	+ 2.75
16. Malmö-Köpenhamn (ferry-boat)	1.1	426	380	+ 46	+ 4.32
Total	1 055.8	191 259	158 093	+ 33 166	+ 3.11

(1) Appropriate share of procuring costs of rolling stock included.
The cumulated construction and procuring costs have not been adjusted to changes in the value of money of different years.

(2) Depreciation but not interest included.

procedure, one requires above all such precalculations as have been treated more exhaustively above under the designation of calculations of profitability.

In addition to what has been said there, attention should be drawn to the following considerations on the practical framing of the above-mentioned system of post-calculation.

The number of groups of lines comprised in the report should not be too great, and each particular group should be selected as far as possible so as to comprise lines having only small volumes of « co-traffic » with other groups incorporated in the report. A selective principle of this nature will make it possible to limit considerably the magnitude of such receipts and costs as are common to several groups — this being an important premise of an economically satisfactory allocation of those receipts and costs between different lines. The more numerous and the shorter the lines incorporated in the report, the relatively smaller will be that internal traffic on the lines the receipts from which will apply to one line alone, and the greater will be the « co-traffic » with other lines that will bring in receipts common to several lines. To eliminate these difficulties to the greatest possible extent, it is, therefore, necessary to confine the reports to a small number of groups of lines, which with respect to traffic are interrelated, and in which the traffic on a line is thus largely internal — so that the bulk of a line's receipts will be separable ones. With regard to the expenditure side too, it is advisable to base the report on a small number of groups of lines which are interrelated with respect to traffic. In this way the common costs for all the groups will be relatively small, and the bulk of the costs will appear as separable ones. Even if common receipts and common costs pertaining to several groups can be substantially reduced by taking major interrelated groups for the report, the remaining common receipts and common costs will nevertheless be, as a rule, relatively substantial.

Each year an account is made for each group of line, in which its own receipts are given first and then its proportion of the common receipts together with other groups. In the aforementioned group accounts these common receipts were allocated to the relevant lines in relation to their transport mileage. This method, although very simple, cannot be considered satisfactory since it gives very low proportions of receipts for the dispatching and receiving lines, particularly if the transport mileage on them is short. In this connection a more reasonable basis of allocation would be first to allocate from the common receipts sufficient amounts to cover the terminal costs on the dispatching and receiving lines, and then to apportion the balance in relation to the transport mileage on the relevant lines.

The receipts thus obtained for different groups of lines might be regarded, in several cases, as a first approximation to the subtractive receipts that would probably be lost if the traffic were temporarily suspended on the relevant group. With regard to the expenditure side, those variable individual costs that would disappear on temporary suspension of traffic are first accounted for in respect of each group of lines; after which the actual variable common costs for several lines are allocated to the relevant lines on reasonable bases of allocation, obtained e.g. by statistical analyses. In this way there is obtained, in respect of each group, a first approximation to the subtractive costs that might be saved if the traffic on the relevant group were temporarily suspended.

These data on receipts and variable costs subsequently make possible a calculation of « the surplus above variable costs » for different groups of lines, and if constant individual and constant common costs are entered, « the surplus above variable costs and constant separable costs » for different groups and the « net profit »

for the company as a whole. Broadly speaking, the data thus obtained on the trend of the « surplus above variable costs » on different groups for a sequence of years are probably the most interesting ones from the standpoint of business economy, and the least arbitrary so far as methods of calculation are concerned.

D. — *Unprofitable railway lines, their relative extent in railway systems and their financial burden to the systems.*

Broadly speaking, the total closing down of a certain line, or a partial closing down of such magnitude as to eliminate the bulk of the operating and maintenance expenses, can usually come into question only with regard either to shorter lines which are mainly of local importance, or to such parts of the railway system the total or sub-total closing down of which would further affect only to a small degree the operating results of the network in general. On primary or secondary lines the closing down of facilities must, almost without exception, be partial.

Closer investigation of the profitability of a certain line often follows the discovery that a substantial decrease in traffic has occurred. This usually leads to investigatory work largely aiming at measures designed to regain the lost traffic and to effect a saving in the operating costs of the line.

That situation in which the closing down of railway operations is economically justified probably arises, in most cases, before it becomes manifest. This because railway enterprises usually have no continuous check on the profitability of different lines or stations. It is naturally difficult to determine whether a decrease in the volume of traffic is largely of temporary nature, and hence should not lead to any other than minor adaptation measures of limited duration within the framework of the existing traffic system, or whether it portends a permanent state requiring more comprehensive and definitive measures. However, a continuous check on the traffic trend on different lines and at different stations, and of all those conditions that might even affect the economy of the different lines in the long run, should be possible, and appears essential if both the nature and degree of the measures and the time for putting them into effect are to be economically rational.

In determining when, where, and how, from the standpoint of business economy, railway facilities or operations should be closed down wholly or in part, the difficulties are relatively smaller for those branch lines which are more readily differentiated from the system as a whole, than for facilities on the primary or secondary lines which from the traffic and operational standpoints are largely interdependent.

To establish more accurately which lines are unprofitable and might therefore, from the standpoint of business economy, come into question for total or partial closing down, thorough investigations are required in each particular case. None of the series of statistics that are regularly worked out are of such nature as to provide any accurate indication of the profitability of a line. In those cases where separate accounts of expenses or receipts are made up for smaller units than whole railway systems, they usually relate to major groups of individual lines, frequently of heterogeneous composition. Hence knowledge of the volume of traffic, etc. on the smallest units of the railway system almost invariably presupposes special investigations. Each individual line must generally be dealt with strictly on its own merits.

As an initial guide in the selection of lines that should be more closely investigated, we can take the traffic density in gross ton kilometres per kilometre of line or « net ton kilometres per kilometre of line » for the different lines of a railway system. If these varying traffic densities of individual lines are arranged in a scale of descending traffic densities, the unprofitable lines may be expected, a priori, to be mainly assignable to the light traffic groups. In this scale of descending traffic

densities it may often be possible, at least very approximately, after having made more intensive studies of the profitability of a number of lines, to establish a rough dividing line or zone of traffic density between profitable and unprofitable lines. At all events it seems of value to determine the proportion of light traffic lines of the total system. Traffic density varies in Sweden between 60 000 and 10 000 000 gross ton kilometres per kilometre of line for normal-gauge lines and between 50 000 and 600 000 for narrow-gauge lines. The distribution of traffic densities for the system is shown in *Table 16.*

Each of the lines selected in this way can subsequently be investigated more closely, at an initial rough estimate, on the basis of available statistical data. In this connection it is often possible to disregard the income side and to assume that the receipts on the whole will be unchanged; it will only be necessary to compare the costs of railway or of road transport operations in each individual case. If the income side too must be taken into account, a rough idea of the importance of a line in this respect can be obtained by computing the number of passenger kilometres and freight-ton kilometres of that line and multiplying it by such average receipts for the respective types of traffic as are considered reasonable with respect to the transport mileage.

TABLE 16.

Traffic density of the Swedish State Railways.

Traffic density in gross ton-kilometres per kilometre of line Thousands	In per cent of total length of normal gauge system	Cumulated percentages of col. 2	In per cent of total length of narrow gauge system	Cumulated percentages of col. 4
1	2	3	4	5
0 — 50	0.0	0.0	2.1	2.1
50 — 100	2.8	2.8	13.6	15.7
100 — 200	3.9	6.7	22.0	37.7
200 — 300	5.0	11.7	32.8	70.5
300 — 400	8.0	19.7	12.4	82.9
400 — 500	8.2	27.9	12.4	82.9
500 — 1 000	24.0	51.9	17.1	100.0
1 000 — 5 000	32.7	84.6		
5 000 — 10 000	14.4	99.0		
10 000 —	1.0	100 0		

In U. S. A., 250 000 net ton miles of revenue freight per mile of line has often been regarded as the « critical point » between profitable and unprofitable operations. Such an undifferentiated mean figure, like the aforementioned profit and loss statements for different groups of lines, may have some value as a « danger signal », but must naturally be used with circumspection. By dividing the lesser used lines into groups with the greatest possible homogeneity of traffic structure and operating conditions, it would assuredly be possible to calculate a number of relatively reliable critical points of this kind.

Data obtained from different railway Administrations show that in recent years the necessity has arisen, in many countries, of investigating the profitability of different lesser used lines and ascertaining whether it would pay to close them down.

Thus *British Railways* are at present examining all branch lines whose earning capacity is in doubt. According to the nature of the traffic and the economies that are possible, services are wholly or partially withdrawn under one or other of the following five headings.

Goods and passenger lines :

I. — Completely closed.

II. — Closed for passengers.

III. — Closed for passengers and partially for goods.

Goods lines :

IV. — Completely closed.

V. — Partially closed.

In its first annual report the British Transport Commission states that the development of a coordinated transport system requires that services which no longer effectively answer a public need shall be withdrawn and replaced by other and more suitable facilities. In the case of railways this may involve the abandonment of a costly investment, since, whilst it is a comparatively simple matter to transfer bus services from one part of the country to another, tunnels, embankments, and bridges are not susceptible of removal. Accordingly, the Commission continues, very careful consideration has to be given to any proposals to abandon branch lines; and the problem is complicated by the fact that whilst the loss in receipts from traffic which is local to the branch can be readily ascertained, it is a matter of some difficulty to ascertain how far through traffic will be lost if the facilities on the branch are withdrawn.

In the same report the Commission reports some experiences of the saving that would be effected by closing down on a greater scale branch lines of smaller traffic density : « It is sometimes assumed that the financial position of the railways would benefit greatly from the closing of all those branch and cross-country lines which from observation appear unable to carry enough traffic to ' earn their keep '. In fact, the scope for savings is limited — partly because economies have already been effected, partly because many branch lines which appear unremunerative are on balance just worth keeping open. Other lines provide alternative routes in the event of an obstruction of a main line, and it may be worth while maintaining them as a form of insurance against emergencies. »

« In this matter there is no clear-cut line of action that would be widely approved. The Commission are often criticized for not closing a larger number of branch and secondary lines; yet when after careful study the decision is reached that a particular line ought to be closed, local opposition is frequently well organized and strong protests are made. It is, however, noteworthy that those who protest are practically never able themselves to offer a solution to the problem of securing enough traffic to make the line self-supporting. »

As to the possibility of rehabilitating the economy of branch lines through rationalization measures, the Commission states :

« Critics occasionally suggest that new methods of operation would enable branch lines to offer a more attractive service and thus to attract sufficient new traffic to pay their way. The fact is that road services are often best suited to scattered rural communities; the branch railway, with stations frequently situated at some distance from village, is under a geographical handicap which no change in operating methods can overcome. »

The Commission has instituted a general branch line survey in conjunction with the Railway Executive and has withdrawn services in all cases where a clear financial saving would be obtained and a satisfactory alternative to the withdrawn services could be provided, e. g. by provision of road passenger services in place of branch passenger trains. When passenger train facilities are withdrawn, contact is made with the Commission-owned or Commission-associated bus companies, and where necessary and practicable, additions are made to the road services. In most cases, however, the Commission has found that nearly all the traffic has already been captured by the road services and the small increment caused by the withdrawal of the railway service, will create no problem.

The investigations into the closing down of branch lines through the Railway Executive Branch Line Committee are conducted according to a special scheme which includes all data that may be pertinent to a decision on whether a certain branch line should be closed down. An example of such a scheme will be found in *Appendix 1* to this chapter. It relates to a proposal to close and abandon the Canterbury-Whitstable branch line, one of the oldest railway lines in the world, and hence should be not only of technical but also of historico-cultural interest. As will be seen from the scheme, information is given under some or all of the following headings : Location; Description; Train Service; Traffic; Possibilities of increase in traffic; Alternative facilities; Annual loss of receipts; Annual reduction of expenditure; Recovery of assets; Staff changes; Objections to proposal; Other items of importance; Recommendations.

The basis for determining whether or not a branch line is unprofitable is a comparison between the estimated annual savings resulting from the proposal and the estimated loss of receipts.

Between January 1st, 1948 (the date upon which British Railways were nationalized) to December 31st, 1950, approval was given to the closing of the following branches, or to the withdrawal of the passenger train services.

	Number of branches	Route mileage
Goods and passenger lines :		
Completely closed	5	37
Closed for passengers	28	254 1/4
Closed for passengers and partially for goods.	3	36 1/2
Goods lines :		
Completely closed	28	120 3/4
Partially closed	18	49

Particulars as to the closing of stations, which is a simpler matter, are given in the Commission's third annual report. Many intermediate and wayside stations have, since the development of road motor transport connecting with main line trains at important centres, ceased to serve any useful purpose. In many cases, however, it is necessary for the station to continue to provide facilities for full wagon loads of traffic to be received and despatched.

The total number of stations authorized for closing, additional to those on lines from which services were withdrawn in 1948-1950, is as follows:

Year	Passenger	Passenger and freight	Freight	Total
1948	23	4	3	30
1949	35	8	17	60
1950	31	8	16	55
Three years' total . . .	89	20	36	145

The net annual savings arising from withdrawal of services in the first three years of the Commission's existence are estimated in round figures (pounds) as follows:

Year	Lines and stations	Stations only	Total
1948	31 000	8 000	39 000
1949	60 000	17 000	77 000
1950	186 000	48 000	234 000
Three years' total.	277 000	73 000	350 000

For investigations concerning closing of branch lines or withdrawal of passenger train or freight train services the Railway Executive has drawn up a special scheme, to be filled up with all details necessary, for estimation of the financial effects of a proposal to close down a line or to withdraw a train service. In a more general survey of the profitability of different lines or different services in a railway system, access to such a routine scheme seems to be of considerable advantage. In view of the fact that the interest of railway administrations is likely, in future, to be directed towards continuous investigation of the profitability of different lines or services to a greater degree than hitherto, the inclusion of this scheme as *Appendix 2* to this chapter seems warranted.

Only a few Administrations have answer-

ed the hypothetical question of which lines they would close down if they had a completely free hand in the matter and had to base their decision purely on considerations of business economy. Those who have answered have invariably stressed the hypothetical nature of the question and have pointed out that actually they would naturally be unable to base their decisions on such considerations alone, but would have to take into account social and other aspects as well. Although this question will not be fully consistent with the actual situation it may nevertheless be of some interest in throwing light on the magnitude of that part of the railway network which, strictly from the viewpoint of business economy, is not profitable, and on the financial burden which it constitutes to the railway enterprise.

Thus in *Eire*, under the stated conditions, the following length of railway lines should be closed down :

	Mileage
Entirely	263.75
Partially; closed for passenger traffic but retained for goods traffic	195.50
Total	459.25

The criteria used in determining which lines come into this category are, broadly speaking, the cost of substituting road services as compared with the cost of operating rail services, and the prospect of providing more efficient service by alternative means. The length of the lines to be partially or entirely closed down amounts to about 23 % of the total mileage (2 028 miles) of the Great Southern Railway, Eire.

The *Finnish State Railways* give the length of lines which possibly could be closed down under the given hypothetical conditions as 507 kilometres, which is about 10 % of the total railway system. The average traffic density of these light traffic lines was about 2 550 train-km, 155 600 passenger-km, and 99 500 goods-ton-km per km of line per annum.

For the *Swedish State Railways*, the length and the traffic conditions are shown in *Table 17* in respect of such lesser used lines the closing down of which would come into question first if such measures were considered solely from the standpoint of business economy in accordance with the hypothetical question. For purposes of comparison, corresponding data are given in respect of the whole system.

With regard to twelve of the twenty-eight lesser used lines shown in *Table 17*, it has been possible to obtain approximate figures (per annum) relating to the number of journeys and passenger kilometres and the number of tons and ton kilometres for carload freight. On the basis of these data a rough estimate has been made of operating results on these lesser used lines. The results, together with other data of interest in this connection, are shown in *Table 18*.

According to the estimates, all lines shown in *Table 18* show a net operating loss, which varies between 4 000 and 18 000 crowns per line kilometre per annum in respect of normal gauge, and between 1 000 and 10 000 crowns per line kilometre in respect of narrow gauge.

If those lines for which rough estimates have been made of the profitability are assumed to be representative of all lesser used lines shown in *Table 17*, the operating of them would result, for the State Railways, in an annual loss of over 10 million crowns on the basis of the traffic conditions, rates, and prices of 1950. However, it is highly probable that more lines than those shown here would be run at a loss.

Some data on the economic position of certain lesser used *Danish railways* were given by a Danish traffic commission of 1936 which investigated the economic position of the privately-owned railways with

special reference to which of them should receive State subsidies for modernizing their operations and a moratorium in respect of previous loans for modernization. The commission divided the privately-owned Danish railways into the following four groups.

I. — Railways that could be assumed to be capable of operation without State subsidization.

II. — Railways of lasting general importance (of importance not only to local, but also to regional or interregional traffic) that were in need of State subsidies.

III. — Railways of importance to local traffic — at all events for a number of years ahead — that were in need of financial support.

IV. — Railways in such a position that

TABLE 17.

	Normal-gauge			Narrow-gauge		
	Lesser used (*a*)	All (1) (A)	(*a*) in percent of (A)	Lesser used (*a*)	All (1) (A)	(*a*) in percent of (A)
Kilometres of line used (yearly average)	864	12 420	7.0	841	2 517	33.4
Train kilometres in millions :						
Passenger trains	2.5	77.4	3.3	2.6	9.7	27.0
Freight trains	0.4	30.9	1.3	0.5	2.4	22.8
Total	2.9	108.3	2.7	3.1	12.1	26.2
Gross ton kilometres in millions :						
Passenger trains	58.8	12 885.9	0.5	40.3	302.0	13.4
Freight trains	64.8	15 516.5	0.4	52.9	332.2	15.9
Total	123.6	28 402.4	0.4	93.2	634.2	14.7
Train kilometres per day per line kilometre	9.4	23.9	.	3.7	13.1	.
Gross ton kilometres per line kilometre in thousands	143	2 290	.	109	252	.
Freight-car axle kilometres per line kilometre in thousands	9	133	.	17	28	.
Empty haulage percentage	27.9	17.6	.	26.7	20.4	.

(1) Excluding iron ore traffic in Lapland.

TABLE 18.

	Normal-gauge	Narrow-gauge	Total
Number of lines	5	7	12
Length of line used	328	467	795
Gross ton kilometres per line kilometre in thousands	197	119	151
Passenger traffic :			
Number of journeys, in thousands	639.5	1 314.6	1 954.1
Passenger kilometres, in thousands	13 146.7	31 447.9	44 594.6
Average distance of journeys, in km.	20.5	37.1	22.8
Freight traffic, carload freight :			
Number of tons, in thousands	216.2	270.1	486.3
Ton kilometres, in thousands	9 926.0	10 036.0	19 962.0
Average transport distance, in km.	45.9	23.9	41.1
Operating estimates, in thousands of crowns :			
Receipts	1 615	3 128	4 743
Expenditure	4 393	4 940	9 333
Surplus	— 2 778	— 1 812	— 4 590
Per line kilometre :			
Passenger kilometres, in thousands.	40.1	67.3	56.1
Ton kilometres, in thousands	30.2	21.5	25.1
Receipts, in thousands of crowns.	4.9	6.7	6.0
Expenditure, in thousands of crowns.	13.4	10.6	11.8
Surplus, in thousands of crowns	— 8.5	— 3.9	— 5.8

TABLE 19.

	Number of railway companies	Length of railways in km	Passenger kilometres per km of line	Freight ton kilometres per km of line	Net operating revenue in per cent of operating costs
Group I	7	142.6	86 500	19 900	3.7
Group II	11	655.5	116 800	38 600	— 7.2
Group III	22	1 046.2	59 400	17 000	— 17.0
Group IV	19	680.9	53 900	12 600	- 27.7
Total	59	2 525.2	71 874	21 082	- 13.4

the commission advised against State subsidization.

Table 19 shows, for each of these groups, the railway length in kilometres, the traffic density per kilometre per annum in passenger and in freight traffic, and the net operating receipts in percentage of operating costs. It is evident from the table that those railways which did not need State subsidization (*group I*) comprised only 142.6 km, or about 6 % of the total mileage of the private railways. However, the figures given relate, as mentioned above, only to the privately-owned railways, which in 1950 had about 40 % of the railway length, 25 % of the tons carried, 4 % of the ton kilometres and 8 % of the passenger kilometres of the total railway system. The bulk of rail traffic in Denmark is in the hands of the Danish State Railways.

For U. S. A. some interesting data are given in an investigation conducted by the Brookings Institution in 1933 (1). An analysis by Mr. E. S. BUTLER showed that in the late nineteen-twenties the light traffic lines with a maximum traffic density of 250 000 net ton miles of revenue freight per mile of line annually amounted to 24.0 % of the total mileage of Class I railways, 73.5 % of the Class II railways, 91.5 % of the Class III railways, and 28.3 %, or 73 300 miles, of the total mileage (258 800 miles) operated by the three classes of railways. This 28.3 % of the total railway mileage in U. S. A. was estimated to have carried less than two per cent of the total freight traffic in U. S. A. in 1928.

(1) MOULTON and associates : *The American Transportation Problem*, Washington, D. C., 1933.

E. — *Measures to increase the profitability of light traffic lines.*

Before the question of closing down light traffic lines and the substitution of road for rail services assumes current interest, railways usually try every possible measure to improve the economic position of such lines. Most of these measures concern reductions in operating expenses, but measures to increase receipts may also be considered.

Future economic prospects for unprofitable light traffic lines depend on a number

of factors, which should be taken into consideration in each particular case. The problem how to attain greater efficiency and economy of operation on these lines will be, in each case, one for specialized study and solution. Managements have to determine whether traffic prospects can be improved, and in what way, if the rate structure is adequate; or whether they can be adjusted upward without causing traffic losses, if operation and management methods are economically sound, or if they can be improved, etc.

Operating methods may vary on these light traffic lines according to the nature and extent of the traffic to be carried, and may generally be said to be simpler than on the main lines. The lower traffic volume on these light traffic lines entails a lower transport standard, and means that specialization in train operations cannot be carried through.

For example, mixed trains may be run (i. e., goods trains with a passenger carriage attached), or the passenger service may be worked by « push and pull » trains. The passenger services on these lines may partly be discharged by rail motor cars. At smaller stations often only one official is employed, who performs both the duties of a station porter and those of a train dispatcher.

The smallest stations may often be operated by agents (contractors) or may be left without station personnel, whereby the selling of tickets and receiving of goods are done by the train crews. Often construction and maintenance standards of rolling stock, and way and structures, as well as operational standards are considerably simpler than on the main line system. As regards the administrative organization the personnel on these light traffic lines may, on some railways, form a common body for all work on the lines, and is thus not specialized and divided, as on the main lines, in those belonging to e. g. way sections, machine sections, and traffic sections.

The small volume of traffic on light traffic lines, and the simplified and rationalized operating methods applied on them, are also reflected in the number of employees per kilometre of these lines. In *table 20* are given comparative numbers of staff on light traffic lines and on railway systems as a whole for some countries.

Most railways apply the same tariffs on light traffic lines as on the rest of the railway system. Some railways, however, have higher tariffs on light traffic lines. Thus in India the practice of applying the rates and fares in force on main lines on an inflated mileage has been in force on some of the branch lines with a view to ensuring an economic return on the capital invested. The question of discontinuing this practice and charging standard rates on actual mileage is under consideration by the Indian Railway Board. The Finnish State Railways apply higher rates on some new branch lines than on the rest of the system.

In the eighteen-eighties the Swedish State Railways for some years, on an isolated railway line in the northern part of the country, applied higher fares and rates, in the latter case by inflating the mileage by 25 %. More recently there have been many proposals to apply lower tariffs on the light traffic lines in the more sparsely populated northern regions of the country, in order to facilitate economic development there. For this purpose the aim has been to use a deflated mileage by calculation of the rates, the proposal being to count one geographical kilometre as a half tariff kilometre in the most sparsely populated areas and as two thirds in other areas. The State Railways have declared that since such a tariff policy is not consistent with business economy and entails a net loss for the railway, the latter, if such tariffs are regarded as desirable from the standpoint of economic policy and hence are carried through, should be compensated for the resulting loss of traffic receipts by a special State subvention.

The prospects of improving the economy of a light traffic line through special measures on the tariff side are, as a rule, fairly remote. A general increase in tariffs is

TABLE 20.

	Denmark	Eire		Finland		Norway		Sweden	
	Light traffic lines	Light traffic lines	Railway as a whole	Light traffic lines	Railway as a whole	Light traffic lines	Railway as a whole	Light traffic lines	Railway as a whole
Average number of employees per kilometre of line :									
1. Station personnel	0.37	0.49	1.96		2.37	0.3	1.8	0.49	1.67
2. Signalmen	0	0.02	0.25			0	0.1	0.04	0.06
3. Level crossing keepers	0	0.05	0.07			0	0.1	0.04	0.04
4. Personnel engaged in maintenance work on the permanent way and signals	0.25	0.46	0.68			0.4	1.6	0.35	0.61
5. All employees	.	.				1.2	6.2	.	.

Note. — On light traffic lines open for passenger traffic, it is estimated that if the passenger trains were discontinued, the number of employees on the lines given above could be reduced on an average by 40 to 50 per cent.

seldom possible since railways, as mentioned above, are usually bound to apply uniform tariffs throughout the railway system. In certain cases it should be possible, with flexible selling methods and a differentiated tariff policy with lower rates (agreed charges, quantity rebates, etc.), to provide the impetus for a larger traffic volume, which may improve the economy of the line.

The problem of economical operation of secondary lines of a railway system was subjected to a complete and penetrating study and treatment at the Thirteenth session of the International Railway Congress Association in Paris, 1937. Three reports (1) were drawn up by reporters concerning economical operation of secondary (light traffic) lines and various methods adopted by railway managements to adjust the operating facilities, safety measures and station organization to the lighter traffic on these lines. The main features of these reports were summarized and the conclusions to be drawn from them were given in a special report (2).

The general policy of railway managements all over the world in respect to operation of secondary (light traffic) lines is to seek to reduce operating expenses as much as possible and to create for their secondary lines an organization particularly suited to the nature of such lines, above all to the volume of traffic and the particular requirements of the users. The general measures taken to reach this aim are usually the following :

« — elimination or restriction of the number of signals; discontinuation or restriction of the guarding of level crossings; reduction of the number of track inspection rounds; reduction of the number of

(1) T. EMERS : *Bulletin of the Railway Congress Association*, November 1936, p. 1183 ff. GRANDJEAN and GILMAIRE : *Ibid.*, p. 999 ff. G. C. PALMIERI : *Ibid.*, p. 1129 ff.

(2) G. C. PALMIERI : *Congress Bulletin*, June 1937, p. 1538 ff.

general overhauls of rolling stock used solely on secondary lines; »

« — adoption of a simplified operating system : attenuation of the rules concerning the signalling in and out of trains, crossings and overtakings, the operation of points, shunting in stations, etc.; »

« — limitation of hours during which the stations are open to the public, both for passenger services and goods services; »

« — simplification of the organization services as regards delivery or forwarding of goods, weighing and handling of parcels, the making up of carriage charges, accountancy, etc. » (1)

For these secondary lines the most important rationalization measure to effect economy and improvement of service has been the use of railcars and small Diesel-electric freight and shunting locomotives, which are particularly well suited for the operation of lines carrying light traffic, on account of their low working expenses, their high speed and other characteristics valuable for working accelerated local services and fast services between larger centres.

For light trains the operating costs of railcars are as a rule considerably lower than for steam operated trains. According to European experiences the operating costs per train mile for railcars are only about 50 % of those of steam operated light trains.

In the special report of 1937 the main advantages of using railcars are given as follows :

« — development and even recovery of traffic thanks to the possibility of increasing the number of trips and stops; »

« — increased average train speeds, with a consequent ecceleration of the traffic; »

« — possibility of effecting considerable savings in working expenses. »

The drawbacks mentioned are :

« — the difficulty and sometimes impossibility of coping with exceptional passenger traffic peaks; »

« — difficulty of ensuring an all-round goods service. »

It is stressed in the special report that one of the most appropriate measures for attaining economies in the operating of stations on secondary lines is to entrust management of small stations to special agents (private persons), bound to the railway company by a contract. These agents are usually considered as contracting parties and as a rule have nothing to do with the actual running of trains. Several railways have also established stations not normally staffed, and halts or stopping points which are not supervised by anyone and at which the service is restricted to passengers and luggage. In such cases tickets may be issued and luggage registered either by the train guards or by the first station after the passengers are picked up or by a junction station, or by the destination station.

A few railways also have unstaffed halts which are open to goods traffic : either small consignments or complete wagon loads. In such cases, consignors have to be present at the halt when a train stops, and it is the train staff who receive and handle the goods. The charges are made out by a neighbouring station. On arrival the consignees, who are advised by the neighbouring station, have to be present and take delivery of the goods from the train.

In this connection it should be especially emphasized that relatively small-scale measures to mechanize or automatize operating methods which might be expected, a priori, to be profitable even for the light traffic on secondary lines, may nevertheless prove unprofitable, strictly from the standpoint of business economy, in such commonly occurring cases where the station staff have to be on duty for other reasons and can execute the work during working hours that would otherwise be wasted.

As pointed out above, the problems and the possibilities of attaining economical

(1) G. C. Palmieri : *Congress Bulletin*, June 1937, p. 1538 ff.

operation on light traffic lines were ably and exhaustively treated at the Paris Session of the International Railway Congress Association in 1937. The conclusions reached there on these matters are still valid. In these circumstances, and since little can be added to the exhaustive treatment of this aspect of the problem that occurred at the Paris session, it suffices here briefly to recount the summaries adopted by the Plenary Meeting of the Permanent Commission of 1937, which in its concentrated form gives the whole problem in a nutshell :

« 1. The organization of the different services on secondary lines of main line systems should have as its aim the reduction of operating expenses to a minimum. »

« The fact should not be overlooked, however, that it is essential to improve the service of both passenger and goods traffic as much as possible in order to recover, at least in part, traffic lost to road competition. »

« 2. The possibility of reducing the expenses must be sought in the field of technical installations, in the domain of the methods of transport and in the adoption of simplified operating methods. »

« 3. Technical installations should be adapted to actual traffic requirements and not require any costly upkeep. »

« Simplification of signalling, and even elimination of signals where possible, simplification of the operation of points and other appliances, discontinuation of guarding at certain level crossings, are all measures frequently adopted, which can be recommended with a view to effecting savings. »

« 4. Substitution of more economical methods of transport for ordinary trains is one of the essential conditions for reducing expenses. From this standpoint, the use of light trains or railcars, when traffic conditions, either passenger or goods, are not against it, gives appreciable advantages. »

« It is also advisable to restrict the number of classes in passenger coaches by abolishing first class and, where possible, also second class. »

« 5. Light trains should be made up with the object of realizing economical operation and utilization. » (For example « push and pull » trains driven from either end, and locomotives fitted for one-man operation.)

« 6. Railcars have undergone a very rapid development, which is worthy of being followed up. They have made it possible considerably to increase the commercial speeds, to increase the train frequency and the number of stops; in fact to greatly improve the working on secondary lines. »

« It is desirable in certain cases that railcars should be capable of being coupled together and of pulling one or more trailers. »

« 7. From the point of view of technical operation the greatest possible simplification of traffic rules is recommended; also the reduction of the number of stations at which operating movements take place. To this end some systems have found it useful to concentrate train control duties in selected stations or in dispatching offices. »

« It can also be advantageous to leave station shunting movements to the crew accompanying the train on secondary lines if this results in a reduction of the total personnel on the line. »

« 8. From the point of view of the commercial organization of stations, the advisability of adopting simplified methods of making out the charges, and of accountancy, should be stressed. »

« 9. Simplified methods of operation, rates application and accountancy make it easier, wherever possible, to commit the management of unimportant stations to private individuals. Such « caretakers », bound to the railway by a contract, usually perform all station duties except those relating to traffic safety. »

« 10. Finally it is advantageous to convert certain small stations or halts into unstaffed establishments, tickets being issued and collected by the train staff, and the goods being forwarded or delivered — when such places are open to goods traffic — as if such places were private sidings off the open line. »

With the aim, inter alia, of making possible general use of their rolling material, railway systems comprising lines of different gauges have sometimes rebuilt narrow-gauge lines to the same gauge as the rest of the system, usually normal. Such alterations have been undertaken during recent

years in Norway and have been much discussed in Sweden too, where the alteration of two lines from narrow to normal gauge has started. In the following, further reference will be made to some considerations and findings that have emerged in Sweden with regard to such measures.

In relation to normal-gauge lines, the transport capacity of narrow-gauge lines is substantially lower, both per passenger or freight car and per train. As regards freight cars, moreover, the smaller freight space on narrow-gauge lines may render difficult or prevent the transportation of bulky objects. Further, the difference in gauge precludes through passenger cars and necessitates, in freight traffic, the rehandling above all of carload freights, insofar as a sufficient number of special cars for transport of normal-gauge railway cars on the narrow-gauge lines (Umsetzwagen) are not available on the relevant railway.

Users of narrow-gauge lines are thus handicapped by the deviation from normal gauge, and from several parts of Sweden have, in recent years, come demands for the remedying of these inconveniences by the alteration of existing narrow-gauge lines to normal gauge. The main argument has been that alteration to normal gauge would serve substantially to promote economic life in the relevant areas, and the demand for dividends on the capital invested in this way would therefore not have any decisive importance. Since such alterations entail increased operating costs, while at the same time the receipts usually cannot be expected to develop sufficiently to yield satisfactory interest on the investment, the result as a rule, from the standpoint of business economy, will be a continuous loss for the system as a whole, which either reduces the net receipts or tends to raise the general tariff level. Hence dividends on the investment must be ascribed considerable importance both for the above reasons and as an indication that such alterations really have had the desired effect on the traffic facilities of the area. But in addition other considerations must be taken into account. The improvement of an unfavourable transport situation in a certain region is a highly desirable aim which in certain special cases may justify in some degree a limited departure from the demand for dividends. However, the determining factors here should be the degree to which the narrow gauge is unfavourable, and whether widening of the gauge would be the most suitable way of effecting an improvement.

The disadvantages of narrow-gauge lines largely apply to carload traffic, in respect of which rehandling charges, breakages, expensive packing, and delays cause considerable inconvenience. Yet they can be partly eliminated, without rebuilding of the relevant narrow-gauge line, by improvements in the rehandling facilities and by the use of special cars for transport of normal-gauge railway cars on the line concerned. However, certain inconveniences in respect of carload freights will probably remain even after such changes, and will have to be weighed against the outlay on alterations of the gauge. Under any circumstances, this rehandling would probably justify costly rebuilding schemes only on narrow-gauge lines with a fairly heavy volume of traffic and a high percentage of rehandled freight.

In respect of merchandise and passenger traffics, the gauge is generally less important. True, the traffic standard in these respects is low on many narrow-gauge lines, but the same applies to numerous normal-gauge lines. The causes are probably the same in both cases; for example, unsuitable course of lines, low technical standards, and above all sparse traffic resulting in few and slow services and rendering difficult the introduction of through long-distance cars, so that changing for passengers and rehandling of freight will be necessary in each case. The passenger traffic may, however, be of importance in the appraisal of problems encountered, as satisfactory passenger traffic communications are naturally an aim in themselves, and moreover should

have a marked effect on the general activity in a rural area.

Substantial improvements in passenger traffic probably are seldom possible merely through widening of the gauge, yet they might be effected, regardless of gauge, by the purposeful use of railbuses and railcars. The higher speed of these vehicles on lines of relatively low technical standard, together with their better acceleration, make possible a higher average speed than could be attained with steam trains. Moreover, more frequent services can be arranged with smaller rail units of this kind. The use of railbuses and railcars ensures, however, not only a higher transport standard but also substantial savings in operating costs on these light traffic lines of normal and narrow gauge.

In summing up these considerations respecting the widening of narrow-gauge lines, attention should be drawn to the risk of exaggerating both the importance of the gauge to the general development of the area served, and the concrete disadvantages of narrow-gauge lines for transport users. Further, any tendency to focus the question on freight traffic will lead to overvaluation of alteration from narrow to normal gauge in relation to other solutions, such as motorizing railway operations or replacing them wholly or in part by road transport facilities. The pertinent question, in appraising questions of this nature, is rather : which transport means, or combinations of means, will satisfy in the most appropriate manner the traffic requirements of the relevant areas, with due consideration to the interests of those areas in relation to the costs ? From the standpoint of business economy, such projected investment schemes as may come into question must also be weighed against all other current needs of investment in the railway enterprise.

F. — *Road traffic as a complement to and substitute for railway traffic.*

In Chapter V the relative economy and the fitness of rail and road transport for different kinds of passenger and freight traffic work under different circumstances were elucidated.

The considerations adduced there regarding « preference fields » of rail and road for freight traffic are substantially consistent with the principles for integration of services by rail and road, issued in 1950 by the British Transport Commission to serve as a directive to the Railway and Road Haulage Executives as to the steps to be taken to integrate their respective freight services. Since these general principles laid down by the Commission in broad outline are apparently valid for every integrated or coordinated transportation system, whether it be an individual railway enterprise with road motor traffic as a complement to or substitute for rail traffic, or a whole national transportation system, it seems justified to mention here the interesting features of this statement of policy as a summary and recapitulation of what has been said in Chapter V.

The general aim of the Commission's policy in these matters may be said to be that rail and road services should be regarded and developed much more as complementary to each other, and much less as rival forms of transport.

Rail transport is regarded by the Commission as specially suitable and efficient for :

1) traffic which can be carried from point to point in train loads;

2) traffic passing from or to private sidings;

3) the trunk haul, free from staging, of most kinds of long distance traffic. This traffic may require increased use of containers and extended feeder or distributor service by road;

4) low grade traffic over any distance, whether travelling in train loads or not, where the rail service is adequate and costs less to provide than the road service;

5) traffic requiring bulk movement and storage before or after transit;

6) large blocks of traffic requiring immediate absorption in the transport system, such as bulk imports ex ship, or industrial output from steelworks; and

7) large blocks of traffic involving unbalanced movement.

On the other hand, *road transport* is regarded as specially suitable and efficient for :

1) local transport work;

2) more extended services up to the distance at which the economy in tractive effort by using rail for the trunk portion of the conveyance is greater than the economy resulting from :

a) avoidance of the extra handling on and off rail:

b) the saving to the trader of the cost and weight of packing material, etc., or of returned empties;

c) the reduction in the risk of pilferage, damage, or loss, made possible by freedom from transhipping;

d) saving in time;

3) traffic where the dimensions of the goods make railway transport either awkward or costly, due to railway loading gauge, or where rail transport would involve dismantling the consignment and carrying it in sections; and

4) household removals and similar traffic where special packing and unpacking is essential, or where a skilled person must personally deliver and erect or fit the goods.

According to this programme of policy, British Railways will in the future use road services wherever this will reduce staging and transit time, and facilitate rail movements in direct loads between main centres. On the other hand British Road Services will employ railways for direct trunk haulage of long-distance traffic of merchandise and car loads where railways can make available suitable terminal facilities, containers, and train services. When railways cannot give suitable service, which for example may be the case as regards overnight delivery at markets of perishable fruit and vegetables, long distance road services must be used. Joint rail and road arrangements are to be made for such traffic of perishables. To allow the making up of through trains on longer hauls extended road feeder and distributor service will be provided. When closing of branch-lines wholly or partly is justified substitute road service, if necessary, will be supplied by British Road Services, which also according to the programme gradually will take over the responsibility for providing all collection and delivery services from or to railheads. Joint rail-road zonal collection and delivery service will be developed, which will provide opportunities for joint use of existing terminals and promotion of new joint terminals on modern lines under single control.

In order to establish a quiet and balanced development of the integration process the transference of trunk hauls to rail should take place concurrently with the increasing use of road vehicles for cross-country traffic and the extended use of road service for feeder and distributor to rail service.

Similar general principles to effect a coordinated transportation system have been suggested both by railways and by industrialists in U. S. A. in various connections during the past few decades, though the call has not been for a nationalized transportation system, but for a private enterprise transportation industry in which the railways would be able freely to use not only railway haulage but also other means of transport, road motor traffic, water traffic, air traffic, etc. in order to make it possible for them in each case to choose the most economical and suitable means of transport or combination of means of transport.

The present system of carrying out transportation by specialized enterprises for railway, water, road, or air transport, should, according to this point of view, be abandoned and replaced by *transportation*

enterprises with access to and using different available technical transport means. In this way real coordination or intergration of transport could be established.

As has been said so ably by Colonel J. MONROE JOHNSON, Director, U. S. Office of Defense Transportation, the customers in transportation have little interest in transportation by rail, by road, by air, by water, as such; what they are really deeply interested in is to get the best possible *transportation* service at reasonable cost, whether that service be rendered by one type of transport or another, or by a combination of several. « Because a *complete* transportation service can rarely be rendered by a single type, it seems both logical and proper that the public be privileged to benefit to the fullest extent, consistent with the preservation of a reasonable measure of competition, from the integration or close coordination of transport which so combines all types of transport as to make it possible for the integrated or coordinated unit to render to the customer the complete service in which he is interested. The justification of any transportation system lies, not in its provision of independent corporate action for existing service units, but in its service to the public: unification — as coordination — must ultimately and properly be adjudged upon the basis of its possible public service rather than in the light of its effect upon the number of separate operating units of some particular type of transport ([1]). »

The attitude of American railways in this respect is evident from the following quotation of a statement of the Association of American Railroads to a special Committee of the U. S. Congress on June 20, 1946 :

« There has been a tendency on the part of many persons to consider railroads, water carriers, motor carriers, pipe lines, and air carriers as being entirely separate and distinct industries instead of being, as they are, merely alternate means of providing transportation for persons or property. The basis for this view is partly historical and partly the supposed interests of the respective agencies of transportation. Representatives of other agencies express the fear that if left free to do so the railroads, because of their greater size and more extensive financial resources, would ultimately dominate the entire transportation field. Such considerations, however, overlook the broad public interest in the matter, which alone should be controlling. The question involved is entirely an economic one and should be dealt with as such... »

« A transportation agency utilizing various modes of transportation in its operations would in its own self-interest perform each operation by the mode best adapted for its performance. It would have no motive to reach after and take from other modes traffic for which they are better fitted than it, thereby increasing the total cost of moving the nation's traffic. »

« It is clearly in the public interest that operation of multiple-type transportation agencies be permitted, as the same degree of efficiency and economy of service cannot be achieved through arrangements for joint service by separate competing interests. »

« Many railroads own subsidiaries which operate as common carriers by motor vehicle. In some instances, however, restrictions have been placed upon such operations by the Interstate Commerce Commission which prevent their utilization to the best advantage and which find no counterpart in the operations of independent motor carriers. Some of the railroads also own or control water carriers, although the laws now in effect, particularly the Panama Canal Act, have greatly limited the opportunities for doing this,

([1]) P. HARVEY MIDDLETON : « Transport Coordination in the United States », *Railway Business Association*, 1946.

contrary, as we believe, to the public interest. Other railroads wish to operate common carrier air service, but are practically prohibited from doing so by the administrative policy adopted by the Civil Aeronautics Board, based in part at least on what we consider to be a misinterpretation of the statute. All such artificial restrictions against the operation of multiple-type transportation agencies should be removed. In urging their removal, the railroads seek no special favors. They simply urge that there should be no discrimination against them or any other type of carrier in this regard. All should be treated alike in this as in all other respects if the public is to receive the best possible service at the lowest cost. »

Railways all over the world have found that road motor traffic in many cases may be an important complement to and substitute for rail service, especially for light traffic on branch lines. In the main, road motor traffic has been used by the railways for the following categories of transport services of passengers and freight :

I) Collection and delivery service;

II) Interterminal transfer;

III) Substitution for line haul rail service on shorter hauls from certain larger stations or centers (railheads);

IV) Substitution for other line haul rail service.

The experiences of railways show that if they are to provide an efficient over-all transportation service they must have the possibility of using buses and trucks either in a coordinated railroad service or solely as a road service. Through such coordinated and substitute road services important economic and ancillary advantages can be obtained.

For both passenger and freight traffic most railways are engaged directly or indirectly in road motor operations as feeders or substitutes to rail services through one or more of the following arrangements : wholly owned subsidiaries of the railway, an affiliate of the railway, by the railway directly, or by a contractor under railway supervision.

Before a branch line is closed down or passenger or freight services are discontinued, wholly or in part, most railways closely investigate the traffic needs of the area concerned to make sure that adequate and reasonably convenient road services can be provided if railway services should be discontinued. In most countries the railway administrations usually contact local authorities and customers concerned and explain in detail the reasons why rail services should be discontinued and how the substitute road services should be organized. As a result of such discussions original plans are often modified to meet various proposals made by local interests.

In most countries, if a branch-line is closed down or passenger or freight service withdrawn, the railways cannot establish a substitute road service unless a public concession is granted. If the railway cannot obtain the concession, for instance because there is already a concessionaire, it cannot start the substitute service. In some countries, e.g. Eire and Finland, however, railways are authorized to organize a road service replacing rail service, but in other cases railways must ask for a concession.

The bus services replacing rail services in light traffic areas do not necessarily follow the exact line of railway route, although serving the same towns and villages. In most cases no additional bus mileage would be incurred for British Railways in carrying the small number of passengers diverted from the trains. Sometimes, however, service would have to be extended or augmented, and in isolated cases considerably more omnibus kilometres than train kilometres might be needed to carry the same volume of traffic.

In those cases where the mode of conveyance — train or bus — can be chosen, the attitude of transport users is found to vary. Broadly speaking, modern buses are probably accepted as an adequate substitute

for trains on short and medium distance routes — up to 50 km — provided the bus fares are not appreciably higher than train fares and that the number of standing passengers is about the same. On longer routes, on the contrary, trains are usually preferred. The public attitude to these problems otherwise is probably dependent not only on the standard of the material used in road and in rail traffic, but also on the distance to the station or bus stop, the frequency of services, the travelling time, etc. In general, the bus lines in the cities and other major agglomerations run to special termini, mostly situated in the business center of the particular place. Hence bus passengers in many cases reach and leave the central parts of these towns more conveniently than railway passengers. Moreover, the bus stops in towns and other agglomerations are arranged at relatively short distances, so that bus passengers are in a more favourable position for reaching their destination without having to use local transport facilities (trams, etc.). Since buses are thus in a better position than trains to meet local requirements and to offer transportation from door to door, certain additional receipts might often be reckoned with by arranging a substitute road service.

After closing down rail traffic on certain routes and replacing it by road traffic, current bus fares have generally been in use. These bus fares, at least in Europe, are often higher than rail fares. In some cases, ordinary rail fares are applied for substitute road services.

Cheap tickets seldom occur in bus services, apart from monthly tickets and school-children's tickets.

A remarkable replacement of rail by road services was the withdrawal by the Ulster Transport Authority, in January, 1950, of the main line train services south of Comber, on the former Belfast and County Down Railway (1). The railway had lost much of its traffic through road competition, owing among other things to the short length of the railways, its sparsely populated traffic area, and the fact that the distances for the most important traffic connections in the area were generally much shorter by road than by rail. To preserve the traffic the railway had established a bus service and some lorry services in its traffic area, yet its economic position was still very unfavourable, and in 1938 the railway operated with a loss of £ 22 000. During the last war, the railway had a period of prosperity, but after the war the economic position again deteriorated and the years 1946 and 1947 showed losses of £ 78 000 per annum. After the formation of the Ulster Transport Authority in 1948, the general duty of which was to « provide, or secure, or promote the provision of an efficient, economical, convenient and properly integrated system of public inland transport for passengers and goods in Northern Ireland by rail and road », a thorough investigation was made of the measures to be taken in order to better the economic results of transport operation in this region, and it was decided that most of the railway lines should be closed down and transportation taken over by road services.

The organization of the substitute road passenger service was facilitated by the fact that prior to the formation of the Ulster Transport Authority the area concerned had been served by both rail and road transport. The preparation of a road time-table was therefore not so difficult as it would have been in a new road traffic area. A preliminary road time-table was drawn up on the basis of material obtained through a comprehensive market and opinion study of the customers in the traffic area. After that the draft time-table was made available for inspection and comments by interested parties. The same arrangements were made as regards replacing road freight services in the area. To deal with the traffic the road freight fleet was considerably augmented by vehicles with capacities of from five to twelve tons.

(1) *Modern Transport*, February 4, 1950.

The possibility of substituting road services for the lesser used railway lines was investigated in Switzerland (1) in 1935. The Management of the State Railways there set up a special commission of inquiry whose members included two experts from the private automobile industry. This commission was assigned to elucidate on which lines a change-over from rail to motor operations might be appropriate from the technical and economic standpoints. It investigated a large number of lines and reached the conclusion that such a change-over would be remunerative in one case only. The investigation was concerned with a number of lines on which motor services might conceivably be substituted for certain trains, with lines on which rail operations might be completely abandoned and replaced by motor traffic, and with lines on which rail buses might be substituted for steam trains. The conclusions reached by these motor and railway experts might be summarized as follows :

1. — Only under certain conditions is it economical to substitute road for rail traffic; namely, where it is a case of passenger trains with a relatively small though regular traffic and where the substituting road traffic will not need to contend with such secondary work as the transportation of fast freight, milk and other foodstuffs, livestock, etc.

2. — In regular traffic, rail operation is superior to road operation, trains having a higher speed and transport capacity than motor vehicles.

3. — Change-over from rail to road operation entails a substantial fall in the transport standard, e. g. a longer transport time for passengers and goods, so that the transport concern might have to suffer losses of traffic.

4. — The arrangement of road services presupposes a softening-up of the transport duties to which railways are subject, which would result in certain drawbacks for the areas served.

5. — The closing down of railway stations presupposes that the dispatching and receiving work relative to the various types of traffic will be taken over by post offices. Quite apart from the fact that most offices lack the requisite space for incoming and outgoing goods, the postal staff is rarely in a position to take over the duties in question.

6. — With a single exception it was found that with the existing traffic volume road services were more costly than rail services. Moreover, road services would be more unfavourable with regard to time schedules and the possibility of coping with peak traffic.

7. — From the standpoint of national defence and supplies, the responsible authorities were against any closing down of existing railways.

8. — The introduction of mixed rail and road traffic — like that of road traffic alone — would require substantial capital investment.

9. — The introduction of motor trains with one or two cars is economically justified as a substitute for passenger trains with but a small number of passengers. But as soon as the traffic shows any seasonal variations, or if mail, fast freight, milk, and livestock transports have to be dealt with, motorized operation will be more expensive than steam operation.

A new Swiss investigation into the same problem was recently presented by Baumgartner (1). Four light railway lines were examined with respect to the profitability of replacing the railway service wholly or in part by road motor service. Like the railway service to be replaced, the new road service should comply with the duties of public transport (same tariffs and obligations as railways). These four case studies

(1) *Zeitung des Vereins Mitteleuropäischer Eisenbahnverwaltungen*, 1936, p. 799.

(1) *Schweizerisches Archiv für Verkehrswissenschaft und Verkehrspolitik*, No. 2, 1951.

showed that, generally, it was technically easier, and economically more profitable, to replace railway service by motor road service on a narrow-gauge line than on a standard-gauge line, and on a steam operated line than on an electrically operated line. When passenger traffic on these light traffic lines was regular and without any prominent peaks, it could be carried out by road motor service without any major difficulties, while carload traffic on standard-gauge lines could be hauled by road service only at considerably increased costs.

The operation of light traffic railway lines is considered to be a financial burden to the Federal Railways in Switzerland, and the length of these unprofitable railway lines is estimated at about 700 km, or about 27 % of the whole system. A road motor service that offers the same tariffs and services as the railway will, however, also be unprofitable to the same extent or even more. Light traffic connections remain unprofitable, whether they be operated by railway or by road service. The fact that a railway line is operated at a loss does not necessarily mean that a road motor service with the same rates and obligations as a railway would cause a lesser loss. In point of fact, according to the Swiss inquiry the number of the light traffic railway lines that could profitably be replaced by road motor service would not be very high. In certain cases mixed operations, with passenger traffic by road service and freight traffic by rail service, would seem to be the appropriate solution. If road motor services were allowed to apply higher tariffs than railways, the substitution of road service for railway service would of course be economically possible to a greater extent.

As an example of the interesting case studies in the Swiss investigation, particulars may be given of the Nyon-Crassier line of the Swiss Federal Railways.

The following five alternative remedies to ameliorate the economic position of the line had been proposed, and were studied as to their probable effects on the revenues and expenses of the line :

Alt. A. — Maintaining railway service. Introduction of Diesel railcars. Withdrawal of train staff and control of tickets by station staff.

Alt. B. — Maintaining railway service for freight traffic, using a Diesel electric shunting locomotive for hauling of freight trains. Passenger traffic is operated by a road bus of the Swiss Federal Railways.

Alt. C. — Maintaining railway service for freight traffic, using a Diesel electric shunting locomotive for hauling of freight trains. Passenger traffic is operated by a road bus of the Swiss Federal Mail Department.

Alt. D. — Maintaining railway service only for carloads of freight, using a Diesel electric shunting locomotive for hauling. Freight in less than carloads is transported by common road operators. Passenger traffic is operated by a road bus of the Swiss Federal Railways.

Alt. E. — Closing down of the railway line and replacing rail service by road service operated by the Swiss Federal Railways.

These five operation alternatives would involve, it was estimated, the following revenues, expenses, and deficits per year : (see following page).

The realization of alternative E, that is, the closing down of railway service and introducing road service, would, however, cause a serious loss of revenues on other parts of the railway network. The Nyon-Crassier line contributes freight carload traffic to the rest of the railway system, corresponding to freight revenues of 170 000 to 210 000 francs per annum. A closing down of the line would mean that a great part of these contributed freight revenues would be lost to common road operators, and the annual deficit, given above, would be correspondingly greater.

From the standpoint of business economy, alternative C seems to be the least unfavourable; but in practice it is consider-

Operation alternative	Amount of investment necessary for instituting the alternative Francs	Annual revenues Francs	Annual expenses Francs	Annual deficit Francs
A	120 000	76 000	119 000	43 000
B	400 000	74 000	116 000	42 000
C	280 000	38 000	62 000	24 000
D	470 000	74 000	128 000	54 000
E	430 000	74 000	145 000	71 000

ed difficult to carry through due to public opposition to the higher fares applied by the mail buses. which are two or three times higher than the railway fares in force on the Nyon-Crassier line. Therefore the choice has to be between alternatives A and B, which entail about the same annual deficit. Alternative A requires a lesser investment amount than alternative B and may therefore be preferable. In the Swiss investigation preference is given to alternative A.

Similar estimates of the profitability of substituting road service for rail service were made in Sweden some years ago. The following four cases may be given as examples.

The calculations relate to four short branch lines, on one of which the closing down was envisaged of passenger, baggage, express, and fast merchandise traffic only. In none of these instances was any fall in receipts anticipated on substitution of road for rail traffic. On the contrary the receipts in one case were expected to rise in consequence of improved service due to the reorganization of traffic, expanded door-to-door service, etc. The results of these calculations are shown below.

	Distance in kilometres	Savings in cost after closing down	Additional cost for substitute road traffic	Net saving
		Thousand crowns		
Line 1 ...	17.4	135	50 to 60	100
» 2 ...	10.5	45 to 50	20	25 to 30
» 3 ...	8.8	80	60	20
» 4 ...	11.7	150	—	150
Total	48.4	410 to 415	130 to 140	295 to 300

In the U. S. railway network of 228 000 miles, reaching every part of the United States, the road operations of the railways are to a large degree auxiliary or supplemental services, and are of relatively small extent, insofar as freight service is concerned. These rail-motor operations have, however, increased with the number of roads suitable for the type of vehicles required in such operations.

The complementary use of road motor traffic by railways in U. S. A. has been dealt with in a report by Mr. P. HARVEY MIDDLETON (1), which shows that railways employ trucks as an efficient and economical substitute for way-train service. It is estimated that the twenty-nine principal railways provide rail-motor service to some 8 600 stations. Railways participate in intercity bus operations and, according to the Interstate Commerce Commission, fourteen of the 147 Class I motor carriers existing in 1940 were definitely railroad owned. The road traffic companies of which the railways were either direct or indirect owners carried, in the same year, 30 % of the passengers and had passenger revenues amounting to 44 % of all Class I motor carriers of passengers.

All major railway systems in U. S. A. have road services of different kinds, and in Mr. MIDDLETON's study it is mentioned that a survey of road operations of 25 Class I railways showed that they had rail-road services for handling merchandise freight on approximately 65 000 route miles, and coordinated rail-bus services amounting to 74 400 route miles. The study also gives brief descriptions of coordinated rail-road services in operation on some railway systems, some of which may be summarized here to illustrate the kind of complementary and substitute road service which is common on major American railways.

(1) P. HARVEY MIDDLETON : « Transport Coordination in the United States », *Railway Business Association*, 1946.

The Atchison Topeka & Santa Fe Railway System.

The Atchison Topeka & Santa Fe Railway System, which operates 13 115 miles of railroad from Lake Michigan to the Rocky Mountains, the Gulf of Mexico, and the Pacific Coast, is the parent company of two wholly-owned motor carriers, the Santa Fe Trail Transportation Company and the Santa Fe Transportation Company of California. The former conducts both bus and truck operations under certificates issued by the I. C. C. and various state regulatory bodies. The latter company conducts intrastate bus operations in California under certificates issued by the railroad commission of that state.

The passenger operations of the Santa Fe Trail Transportation Company extend from Chicago to Los Angeles, San Diego, and San Francisco, Calif., and reach Hot Springs, Ark., Oklahoma City, Okla., and Lincoln, Neb. These operations cover approximately 12 732 route miles in the states of Illinois, Missouri, Arkansas, Oklahoma, Nebraska, Colorado, New Mexico, Utah, Arizona, Texas, and California. At the present time 312 buses are in operation over these routes.

The freight operations of the Santa Fe Trail Transportation Company cover approximately 6 700 route miles in the states of Missouri, Kansas, Oklahoma, Nebraska, Arkansas, Colorado, New Mexico, and Texas. There are some 670 pieces of freight equipment in operation. More than 2 800 persons are employed in the combined passenger and freight operations. Most of the bus and truck routes of the Trail Company either parallel the Santa Fe rail lines, serving rail stations, or lie generally in the territory served by the railway company.

Coordination of services has been established between the Santa Fe Railway Company and the Trail Company in both passenger and freight operations. Tickets sold by the Santa Fe Railway are honored by the Trail Company for bus transportation between Santa Fe rail stations in inter-

state commerce and in intrastate commerce in most states. In California the intrastate rail-bus coordination is conducted through the Santa Fe Transportation Company of California.

Rail-truck coordination is widespread over the Trail Company's system. The coordination consists of rail-truck, truck-rail, rail-truck-rail, and truck-rail-truck service, under which the Trail Company handles LCL freight for the railroad under the railroad's bills and tariffs, and the railroad handles freight originated by the Trail Company where the volume of such freight makes that operation practical. In effecting this coordination the truck and the rail facilities are consolidated wherever possible and railroad personnel, including station agents, terminal employees, etc., handle Trail Company freight and local clerical matters. Through establishment of coordinated freight service the Santa Fe Railway Company has effected a saving of 5 192 merchandise cars per month, which, when formerly operated in rail service to handle the freight now transported by truck, accumulated approximately 777 365 car-miles per month.

Chicago Burlington & Quincy Railroad.

The C. B. & Q. railroad system is a modern railroad system of 9 000 miles, serving 1 600 communities between the Great Lakes and the Rocky Mountains. Through the controlled Colorado & Southern and subsidiaries extending southeastward from Denver, the Burlington reaches Galveston on the Gulf of Mexico.

The Burlington Transportation Company (a subsidiary of the C. B. & Q.) was organized in 1929 for the purpose of engaging in highway transportation as a common carrier. Initial motor bus operations were established over routes 800 miles in length. In the 16 years of its existence the motor bus routes have expanded into a system of 8 250 highway miles, serving much of the territory served by the C. B. & Q., and extending west of the Rocky Mountain area to the Pacific Coast.

Motor truck operations, established in 1935, have developed from 2 500 miles of route to 5 000 miles. Total operating revenue from bus and truck operations in 1944 was approximately $ 10 million. While most of the Burlington Transportation Company's bus and truck traffic moves all-highway, there is performed a substantial volume of coordinated rail-highway service which has resulted in benefit to the public through expedited — and in many cases more frequent — transportation service and through operating economies. The most practicable and effective methods of coordination developed gradually as a result of experience and study.

Administration, operation, and maintenance of the highway operations are kept in the hands of men experienced in highway transportation, without interference by the railroad. The truck and bus divisions likewise are operated quite independently of one another by men experienced in those special fields.

The Burlington Transportation Company utilizes and pays for C. B. & Q. facilities and personnel where such utilization is practicable.

New York Central System.

The New York Central System operates about 11 200 miles of railroad in eleven states and Canada, serving the great industrial area between the Atlantic seaboard and the Mississipi valley. This is a highly competitive territory which is also served by numerous other railroads and Class I motor carriers. During the last 20 years the New York Central has, in connection with other improvements to its merchandise service, entered into motor coordinated transportation by means of contracts with existing motor carriers. The railroad itself does not own or operate any motor vehicles in revenue service.

It operates substituted freight service over the highways in order to improve its way freight LCL service, and to effect economies in such operations.

It has proved effective with respect to

each objective, making it possible in most cases to reduce or eliminate overtime, and to improve way freight schedules. It has also materially reduced the number of box cars in local service and increased the ton-miles per day per car on those remaining. The freight handled in this service moves on railroad bills of lading and at rail rates. Joint rates are not involved.

The New York Central employs approximately 50 over-the-road substituted freight service contractors. They operate nearly 150 local routes, aggregating about 2 500 route miles. These extend parallel to the railroad from nearly 100 strategically located concentration points where merchandise freight is transferred between box car and truck, and provide service to nearly 500 local way stations. This service now handles about 25 000 tons per month.

The contractor in these instances is deemed an independent motor carrier. In most cases the contractor must have interstate and intrastate certificates as a common carrier of general merchandise over the specified routes. Many of the contractors working for the New York Central have certificates which restrict them to service which is auxiliary to or supplemental of the railroad. Only a few of the substituted freight service contractors at present engaged are Class I motor carriers.

The railroad ordinarily loads and unloads the trucks at the concentration points, with a driver generally present to assist. At way stations the driver and the local agent, or a clerk, cooperate in handling the freight. The contractor is responsible to the railroad for all loss or damage to freight in his charge, and assumes liability for injury to his employees, or other, and for property damage. The railroad assumes its usual liability to the shipper.

The New York Central System at present has about one-quarter of its road mileage paralleled by such coordinated motor service.

At over 150 terminals and interchange points throughout the New York Central System local truckers are engaged under contract to transfer interline LCL freight to other railroads. Experience indicates that it is generally quicker and frequently more economical than to perform this work by switching cars.

The New York Central has over 450 contractors performing pickup and delivery service at stations throughout the system. Pickup and delivery service is provided at about one-third of all system stations, although this fraction rises to about one-half after excluding nonagency stations. The number of stations at which pickup and delivery is provided does not alone reflect the true picture, because those stations where this service is not provided handle only about 3 % of the total LCL freight. Both trucks and tractor trailers are used in these various operations. No special equipment, such as tank trucks or refrigerated trucks is required for these operations.

The New York Central Railroad itself does not own or operate any buses. It has had, however, since 1935, a 45 % interest in the Class B (voting) stock of Central Greyhound Lines, Inc., the remainder of which is controlled by the Greyhound Corporation.

Central Greyhound operates under its own management more than 6 000 miles of route, generally paralleling the New York Central System from New York and Boston to Chicago via the main line and Michigan Central routes. Its operations also extend from Albany to Montreal and traverse, in addition, other lesser routes within the territory. In certain cases these bus operations have proven worthwhile supplements to local passenger service.

Gulf, Mobile & Ohio Railroad.

The Gulf, Mobile & Ohio Railroad operates some 2 000 miles of railroad, and is an excellent example of a railroad which has coordinated its operations with highway transport.

Rail-highway service was inaugurated in a small way in the 'thirties, and since that time has grown to such an extent that

today every point of the G. M. & O. is served by buses and trucks of a wholly-owned subsidiary, the Gulf Transport Company, which owns and operates 161 units of highway equipment, including 62 tractors, 13 trucks, 50 flats, 34 vans, 1 trailer, and a tank truck. An average of 182 000 truck miles are operated every month over 1 811 miles of highways.

The coordinated truck-rail service provides for the loading of through package cars to distribution points, where the merchandise is transferred from cars to trucks and fanned out over the territory for a distance of approximately 100 miles. Trucks pick up freight at way points and transport it to the principal distribution points. Through merchandise cars are made at these principal distribution points from the inbound trucks, enabling the railroad to expedite the movement of its outbound merchandise.

The truck routes are arranged and scheduled so as to tie in with the railroad's trucks operated out of other distribution points. The railroad is able to obtain an orderly flow and continuity of movement of LCL traffic throughout its territory. The flexibility of this coordinated service has not only expedited the handling of its merchandise but has proved economical.

The Gulf Transport Company also operates four feeder lines. Service is rendered to inland towns handling both less than carload and carload business on joint rail-motor rates. Empty trailers are placed for loading by the shipper at the inland town, and the load is then handled to the railhead and transferred to car by Gulf Transport Company. Inbound carloads are transferred by Gulf Transport from car at the railhead, and the receiver unloads the trailer at destination.

Generally, pickup and delivery service is performed for account of the railroad by contract draymen, unless the shipper or receiver elects to perform his own service under the regular tariff allowance. At some points the Gulf Transport Company performs the service for the account of the railroad, and this has enabled it to provide the public with pickup and delivery service at those places where it has been unable to arrange satisfactory contracts with local draymen.

Highway passenger service, coordinated with rail service, is also operated by Gulf Transport Company with a fleet of 69 buses having a total seating capacity of 2 075. Bus service averaging approximately 318 000 bus miles per month is operated over 1 750 miles of highways generally paralleling the G. M. & O. and serving substantially all important railroad stations. On lines where both passenger trains and buses are operated, schedules are staggered to afford convenient and frequent services. Rail and bus tickets are interchangeable at the passenger's option between points where service is provided by both agencies. An average of over 3 600 passengers per month have taken advantage of the interchangeability of tickets to secure for themselves the most convenient accommodations for their trip.

On lines where passenger train service has been discontinued and bus service substituted, the bus schedules are coordinated with passenger train schedules at interchange points, providing convenient and continuous service, including through tickets and baggage checking privileges.

In emergencies such as washouts, derailments, etc., causing interruption to railroad operations, buses are provided to relieve the situation, to enable passengers to continue their trip over the rail lines without serious delay or inconveniences.

Both buses and trucks handle considerable U. S. mail and express for the account of the railroads, relieving overloaded passenger trains or substituting entirely for passenger train mail and express service on lines where train service has been discontinued.

Pennsylvania Railroad System.

The Pennsylvania Railroad operates over 11 500 miles of line from the eastern seaboard through the Middle West to Chicago and St. Louis. Including the District of

Columbia, its operations extend into thirteen states.

In the early 'twenties, in order to improve service and reduce the number of « peddler » freight trains (because of their interference with through traffic), the Pennsylvania Railroad inaugurated substituted service for the handling of LCL traffic. Merchandise freight to and from outlying stations was moved through zone concentration points by motor truck, giving all stations within the zone the same service as the zone or central stations. In addition to economies resulting from this change in the method of handling the freight, movement was expedited and the all-round performance materially improved. At the present time there are 239 station-to-station routes in operation, covering 9 008 route miles daily. During the year 1945, 560 413 tons of LCL freight were handled in substituted service.

About the same time the benefits from station-to-station operation were becoming apparent to railroad management, consideration was also being given to the movement of LCL freight by motor vehicle from one station to another within the same terminal area. Advantages similar to those secured from substituted service likewise resulted in this form of terminal transfer. The service was extended to include not only LCL freight moving from one Pennsylvania Railroad station to another in the same city, but also to interchange from a Pennsylvania Railroad station to a station of another railroad. Intraterminal service via motor truck is at present being rendered in 113 cities.

Effective December 1, 1933, the Pennsylvania inaugurated pick-up and delivery service on a system-wide basis. Free service was provided in a 260-mile zone, and beyond that an additional charge was made. On May 6, 1936, the I. C. C. approved the removal of the 260-mile limit. At present pickup and delivery service is afforded at 1 232 Pennsylvania Railroad stations, which involves the use of 910 different truckers.

The Pennsylvania Railroad at present has a financial interest in twenty different trucking companies, nine of which are wholly owned. During 1945 these companies rendered 96.2 % of the substituted service and performed 54.3 % of the pick-up and delivery service for the Pennsylvania Railroad.

In the development of LCL traffic many stations were found to have insufficient traffic to justify the movement of a through car from the principal producing areas. To meet these situations, the Pennsylvania designed containers which are loaded five to a flat car. Origin stations load freight for specified destinations in the containers so that when the car leaves the origin station it carries containers for five different destinations. The car moves to a transfer station at Enola, Pa., near Harrisburg, where the containers are shifted by an overhead crane, and when the car leaves the container transfer it contains five containers for the same destination. As the transfer of containers is done in the period allotted to the shifting of cars in the train there is no loss of time, and it means that through the use of containers smaller points for which traffic would ordinarily pass through transfers, receive the benefit of a through movement the same as if loaded in a box car.

In 1931, a new form of rail-truck operation, the demountable truck body, was inaugurated between New York, Philadelphia, Baltimore, and Richmond on a limited basis. Under this arrangement truck bodies are loaded by the shipper and hauled by truck from his place of business to the rail station, where they are transferred by crane to a rail car and moved in rail freight service to destination. The reverse operation takes place at the destination station.

As a result of the efforts to improve the transit time for LCL traffic, the Pennsylvania has maintained its position as the foremost handler of LCL traffic in the country. In the year 1945, it handled 5 061 574 tons of LCL traffic, and indica-

tions are that this figure will closely approximate 6 million tons for the year 1946.

During the middle 'twenties the Pennsylvania Railroad saw long-haul bus lines established paralleling its more important rail lines, with the resultant loss to passenger revenue. In 1928, it acquired a 50 % stock interest in Pennsylvania Greyhound Lines, Inc., and through coordination, was able to eliminate many unprofitable passenger train miles. At the present time, there are eighteen routes operated by bus lines on which rail tickets are honoured, mostly in branch line territory where all passenger train service has been eliminated.

Not only in U. S. A. but also in many other countries, e.g. France, Great Britain, and Sweden, zonal collection and delivery of freight has been organized during recent decades, comprising as an essential part the movement of freight, especially merchandise, between local stations and railheads forwarding the traffic and between receiving railheads and local stations from which delivery is made.

In Sweden, such zonal road service has been operated for several years by the State Railways. It relates to that truck traffic which deals with the transportation of rail merchandise along certain railway lines, both between a railhead and stations along the relevant line or directly between the railhead and customers along the truck route, and between stations along the route, or between the customers themselves. Hence the goods transported are in great part railway goods, and the customer pays the usual railway charge from origin to destination. In those cases where goods are collected from or delivered to the customer directly, an additional charge is usually made, based on the distance from the nearest railway station to the customer.

Zonal trucks run according to time and transport schedules. The basis of these is that goods from the railheads must reach customers at the intermediate stations as soon as possible, and conversely that goods from the latter must reach the railheads in time to be forwarded the same day.

The chief advantage of zonal road service is that it constitutes a rationalization of operations. Possibilities exist of relieving heavily used lines of local freight traffic. Since the merchandise cars of local freight trains no longer have to be shunted at the intermediate stations when the freight is transferred to the zonal trucks, it has been possible substantially to reduce scheduled travelling times of local freight trains, the result being lower operating costs, possibilities of improved train running on the line in question, and speedier conveyance of the freight remaining in the train. Further, it has been possible to withdraw completely local freight trains on light traffic lines following the introduction of zonal truck services.

The Swedish State Railways last investigated the economic outcome of zonal truck service in *February, 1951,* the results being shown in the following table.

Savings in costs due to cuts in :	Amount in thousands of crowns
Car days	155
Locomotive costs	242
Personnel costs (excluding locomotive crews)	32
Total . . .	429

The costs of zonal truck service amounted to 116 000 crowns. Hence the gain from rationalization amounted to 313 000 crowns per month or about 3.8 million crowns for the whole year. The value of car days saved by the introduction of zonal road service naturally varies according to the traffic intensity, being greatest when a marked shortage of cars exists and least when there is a surplus of cars. In respect of 1951, however, the zonal truck service would result in a direct profit even if the car days saved were evaluated at zero.

Quite apart from these gains with regard

to operating costs, the zonal truck scheme enables the railways to offer an improved service, and hence has become a major factor in the competition with road transport in general. Moreover, damage to goods has probably been reduced because it has been possible in many cases to reduce the number of rehandlings.

The Swedish State Railways run bus services both directly under their own management, and through a wholly owned limited company. Together these two bus organizations own about 1 800 buses and are operated over 33 900 kilometres of road all over the country, which constitutes about 24 % of the total number of buses and about 34 % of the total length of bus routes served in Sweden.

The State Railways' network of bus lines in the northern parts of the country is far less dense than in South and Central Sweden, this being partly due to the fact that bus traffic under State management in the north is also run by the Swedish Post Office (190 buses, 4 700 km of routes served).

The State Railways' road traffic was from the outset entirely embodied in the railway organization. Routes that geographically belonged to one another formed a group, the management of which was entrusted to a suitable station-master. The groups within a section were put in charge of the section manager, who in turn was subordinate to the District Management. One of the disadvantages of this organization, however, was that road-traffic matters assumed the character of a side-line. As the road traffic acquired ever greater scope a new organization was gradually evolved. The bus-route groups have been enlarged and the management of one or more such groups has been entrusted to officials especially allotted for the purpose — bus-route supervisors and bus managers, who have been made subordinate either to the Traffic Inspector or, in the case of the major line groups, to the District Superintendent's expert in road-traffic matters, the Road Traffic Inspector. Where the smaller bus routes are concerned the station-master still functions as manager, but in that case he has a special « motorman » at his disposal. The supervision and control, etc. of the bus services are mainly in charge of the Board's Road Traffic Bureau.

The passenger traffic is divided into regular line traffic and order traffic. Licences for line traffic are issued by the County Council if the traffic route is within one county only, otherwise by the State Motor Traffic Board. When licences are granted, time-tables and fares are fixed at the same time. The Swedish State Railways, however, obtain their licences from the Government and are allowed to fix their time-tables and fares themselves.

Licences for order traffic are given by County Council except where the main centre is a town, in which case the police grants the licences.

The State Railways' road traffic comprises, in the main, line traffic by bus. In 1950 the line traffic accounted for 52.7 million bus-kilometres and 44.2 million crowns in revenues and the order traffic for 4.2 million bus-kilometres and 6 million crowns in revenues. The latter is, however, of great importance as a supplement to the line traffic, as it provides a better utilization of the available buses and thus contributes to a better economic result. Of the line traffic about 20 % consists of services running parallel to the railway and 80 % of collecting and dispersal services.

The fares on the bus routes are as a rule somewhat higher than railway fares. However, the bus services and the railway have issued similar regulations to govern the period of validity of tickets, the calculation of the price of tickets for children and school-children, etc. The same forms of tickets are used as on the railway, viz., single, return, and monthly tickets. In addition, the bus services provide « school cards » for pupils under 20 years of age, valid for one school term.

Bus return tickets are also valid for return journey by train on routes where both means of travel are available. Month-

ly bus tickets and school cards entitle the holder to travel on the same routes either by bus or by train at his option.

Joint traffic is organized between the railway and certain major localities along the bus routes. This joint traffic provides for the sale of direct tickets and the direct registration of luggage, and also for the dispatch of express goods. The system of sectional charges (on crossing frontiers) is applied. When a reduction in fares in joint traffic between the railway and the bus lines is permitted, though it only occurs in a few cases such reduction is borne by the railway.

For the sale of single and return bus tickets, use is very largely made of ticket machines, which are either fixed or portable. On the tickets printed by machine the regular bus stops are indicated by numbers.

In the drawing up of time-tables for bus traffic every possible consideration is given to the times of arrival and departure of trains at railway stations where the buses stop. The bus time-tables are therefore not fixed until the railway time-table for the relevant period is definitely settled. The changes in the railway and bus time-tables are effected concurrently in spring and autumn.

On routes that run parallel to the railway bus services are so planned as to supplement the railway connections. When it is considered that a certain train service ought to be suspended owing, for instance, to low passenger frequency, a bus service is generally organized to replace that train. On some railway routes is has been possible to avoid extending the train schedule by establishing bus connections instead of trains services at times of day suitable to the passengers. This applies particularly when requests are made for new school trains.

In recent years the passenger service has been entirely suspended on lines showing low traffic frequency and has been replaced by a road bus service, which has meant a saving for the railway. This measure has not adversely affected the means of travel for the travellers concerned.

At the principal public holiday seasons, Christmas, Easter, and Mid-Summer, when accommodation on the trains is often insufficient, buses are put into service to supplement the train services, among other centres from Stockholm to the most popular tourist resorts.

The State Railways' stations and public office premises are used in the service of the bus traffic if they are located in places suitable for that traffic. Further, the railway's control offices, accounting offices, ticket and form offices, and other places of administration are likewise used for the purposes of the bus traffic. The railway's travel bureaux also function as sales offices and agents for the bus traffic, and organize excursions and circular tours by bus in different parts of the country. The railway's telephone and postal services are resorted to for communications between the various offices serving the bus traffic.

In remuneration for the railway's arrangements and services utilized by the bus traffic, the latter is charged such amounts as correspond to the estimated actual costs thereof.

Every endeavour is made to maintain as good cooperation as possible between the State-owned and the privately-owned bus traffic. To this end the two systems have collaborated in arranging for the joint use of bus stations, for uniform tariffs covering both line and charter traffic, for applying the same period of validity to return tickets, for common stopping-places, etc. In the event of private owners desiring to transfer their business, they are in many cases acquired by the State Railways. During the period 1935-1950 private bus lines were bought up for a total amount of about 22 million crowns. With a view to facilitating and improving travel by bus over long distances, an effort is made to collaborate with private bus companies, inter alia, in the issuing of through tickets and providing for suitable tour connections.

APPENDIX 1.

SCHEME No. S. 5.

RAILWAY EXECUTIVE BRANCH LINES COMMITTEE

Proposal to close and abandon the Canterbury-Whitstable Branch, Southern Region.

1. *Location.* — Branch connects Whitstable Harbour with the Ashford-Canterbury-Ramsgate line by a junction at Canterbury West.

2. *Description.* — Single track with a route mileage of 6 m 23 c and a total mileage of 8 m 46 c. It is open for freight traffic only, the passenger service having been withdrawn in 1931. There is one tunnel the dimensions of which restricts its use to open wagons. There are no intermediate stations or sidings. There are 6 public road level crossings, 3 of which are gated, and 15 occupation and public footpath crossings.

   Whitstable Harbour is within one mile of Whitstable & Tankerton Station on the main line from London to Margate via Faversham.

   The tunnel and a bridge in Whitstable are claimed to be the oldest structures of their kind in the world.

3. *Train service.* — One trip per day in each direction.

4. *Traffic.* — The estimated volume of railway traffic and receipts for 1949 adjusted to reflect the 15th May, 1950 increase are as follows :

		No.	*Receipts*	
A. *Local to branch*				
Freight			Nil	
B. *Through*				
Freight		*Tons*	£	
General merchandise	Outwards	6 786	2 776	
	Inwards	96	306	
Coal class	Outwards		Nil	
	Inwards	8 021	10 531	
Other minerals	Outwards	79	11	
	Inwards	192	423	
Livestock			Nil	
				14 047
C. Miscellaneous receipts rents				76
Commercial advertising				3
			Total	14 126

The volume of traffic for the years 1938 and 1948 was as under :

		1938	1948
		Tons	*Tons*
General merchandise	Outwards	13 914	7 988
	Inwards	—	—
Coal and coke	Outwards	8 514	11
	Inwards	3 712	7 368
Other minerals	Outwards	13 674	81
	Inwards	—	—
Livestock		Nil	

Outwards coal traffic amounting to 8 514 tons in 1938 has by now disappeared. Inwards coal has increased from 3 712 tons in 1938 to 8 021 tons in 1949. This is due to the fact that coal previously brought in by water and sent forward by rail from Whitstable Harbour now passes by throughout rail. Coal for town consumption now comes by rail whereas before the war it came by water.

5. *Nature and flow of principal traffics.* — *Outwards.* — Principally loose grain brought in by water and passing mainly to Ashford, Kent.

Inwards. — Mainly coal with occasional consignments of manure, bricks and potatoes for local town consumption.

There is no inwards traffic for shipment from the Harbour.

6. *Possibilities of increase in traffic.* — The number of vessels using Whitstable Harbour has declined from 150 in 1935 to 6 in 1949 and barges from 294 to 213 in the same period. It is not considered that there will be any development which would lead to an increased flow of traffic by rail.

7. *Existing cartage facilities (including railhead schemes).* — No carted traffic is dealt with on this branch.

8. *Proposal.* — To withdraw the freight service, abandon the line and recover materials.

9. *Alternative services or facilities available or proposed.* — The inwards traffic could be dealt with at Whitstable & Tankerton station. An additional siding and possibly coal pens would require to be provided at that station for which the « shot » estimate is £ 6 000 - £ 7 000.

The Road Haulage Executive is prepared to provide direct road conveyance of the outwards grain traffic to Ashford, Kent, if called upon.

The present rail rate from Whitstable to Ashford for grain is 7/7 d. per ton, S. S. 50 ton lots.

The Road Haulage Executive have quoted a tentative figure of 8/— per ton for 50 ton consignments.

10. *Recommendation on future charging of traffic.* — Traffic would be dealt with at Whitstable & Tankerton, and charged at that station's rates which, for the major portion of the traffic involved, are the same as Whitstable Harbour rates.

11. *Change in classification for permanent way repairs and renewals.* — Line to be abandoned.

12. *Future use of removal of track, stations, buildings, etc.* — All permanent way, Harbour turntables and truck weighbridges to be recovered. Quay surfaces affected to be made good in dry filling. Public level crossing gates to be removed and fences provided across the line of railway. The Estate and Rating Surveyor will be asked to dispose, where possible, of land and buildings outside the Harbour premises.

13. *Continuing liability for repair and renewal expenditure if branch closed.* — Maintenance of bridges, fences, etc., per annum £ 425*.

Maintenance of estate property £ 28.

* This includes provision for disinfestation.

These charges will continue until such time as the land is disposed of.

14. *Heavy items of repair and renewal expenditure due in the next few years if branch kept open.* — Nil.

15. *Estimated annual loss of receipts.* — Grain traffic (forwarded) ..... £ 2 776

Other minerals (forwarded) 11

£ 2 787

Less 33 1/3 variable working expenses 929

£ 1 858

Estate and Rating Dept. (Rents) 51

Trade advertising 3

£ 1 912

16. *Estimated annual reduction in expenditure.* — Repair and renewal of way works and estate property ..... £ 2 894
Maintenance of rolling stock and train working expenses, including staff 1 130
Station, etc., expenses 1 526
Interest savings 897
6 447
Deduct repair and renewal of new siding at Whitstable & Tankerton. 50
Deduct interest on estimated capital cost of siding at Whitstable & Tankerton 227
277
Net reduction ..... £ — 6 170

17. *Estimated increase in net revenue.* — £ 4 258.

18. *Staff changes.* — The undermentioned whole units of staff will be withdrawn :

1 General Foreman, Class 5 — 1 Ganger.
1 Numbertaker — 1 Sub-Ganger.
2 Shunt Horse Drivers — 2 Lengthmen.
2 Crossing Keepers.

The following additional staff will be required for supervision of work at Whitstable Harbour, at present shared between certain of above traffic grades :

2 Dock Toll Collectors.

19. *Recovery of assets.* — Net value of recoverable material.

	£	
Chief Civil Engineer	909	
Signal & Tele. Eng.	185	DR.
Estimated sale value of land, etc.	1 150	
Total	1 874	
Tonnage of serviceable steel	431	tons
Tonnage of serviceable cast iron	235	»
Tonnage of scrap steel	683	»
Tonnage of scrap cast iron	243	»
No. of serviceable sleepers	10 000	
No. of scrap sleepers	7 450	

Original cost of assets to be displaced :

	£	
Estate & Rating Property	14 971	
Chief Civil Engineer	11 967	
Signal & Tele. Engineer	462	
	£ 27 400	

20. *Objections to proposal. — Legal.* — The Chief Solicitor states that there are no legal objections to closure of the branch. There are however two leases with Messrs. Brett & Sons covering the construction and use of a siding at the harbour, from which release will have to be obtained; difficulty is not anticipated.

Local Authorities. — Local Authorities are opposed to the proposal.

Other. — Traders similarly are unfavourable to the proposal and the General Council of British Shipping has expressed concern to the B.T.C. about the effect the closing of the line will have on the port of Whitstable.

21. *Other items of importance.* Having regard to the historic interest of the Canterbury and Whitstable Railway it is likely that a decision to close it will lead to considerable popular opposition, largely on sentimental grounds. The Local Authorities have, from time to time, urged the re-introduction of passenger services, but in view of the excellent road services (operated by the East Kent Road Car Co. — partly B.T.C.-owned), no justification has been seen for acceding to their request.

22. *Recommendation.* — That the freight train service be withdrawn, the line abandoned and materials recovered.

The position of Whitstable Harbour is also, under consideration and will be the subject of a separate report.

Appendix 2.

THE RAILWAY EXECUTIVE

..... REGION

..... BRANCH LINE

Estimated financial effect of adopting proposals to :

Withdraw Passenger train service;

Freight train service;

Close Line to traffic:

Abandon Line.

SUMMARY

Per annum

(1) Estimated net reduction in branch line expenditure . . . . . £ _____

(2) Estimated interest savings . . . . . £ _____

(3) Estimated loss of branch line revenue :

(i) Branch line local traffic receipts

(ii) Miscellaneous receipts, rents, etc . . . . . _____

£ _____

£

(4) Estimated net loss of contributive value from through and through-through traffic :

Passenger train traffic :

Estimated loss of gross receipts

Freight train traffic :

Merchandise (classes 7-21) and livestock :

Estimated loss of gross receipts

Less estimated variable working expenses 33 1/3 %

_____

Minerals and merchandise (classes 1-6),

Coal, coke and patent fuel :

Estimated loss of gross receipts

Less estimated variable working expenses 33 1/3 %

_____ _____

£ _____

(5) Estimated increase in railway executive net revenue from adoption of proposals (1) + (2) — [(3) + (4)]

£ _____

ESTIMATED NET REDUCTION IN BRANCH LINE EXPENDITURE

Per annum
£

Maintenance of way and works and estate property

Maintenance of rolling stock and train working expenses (including guards)

Station, etc., expenses

Cartage

Deduct estimated cost of providing R. E. road services in lieu of rail services less estimated additional cartage revenue

Estimated net reduction in branch line expenditure £

Estimated Interest Savings.

Rolling stock — Estimated effective savings of complete units

Gross replacement cost

Permanent way, buildings, etc., to be abandoned and/or displaced :

Earthworks to be excluded on the grounds that they have no life.

Accrued renewals (based on net replacement cost and 2 % sinking fund)

Add net recovery value of displacements

Estimated value of land, etc., to be sold

Less estimated additional full time units of R. E. owned cartage equipment Gross replacement cost

Total

Estimated interest savings (*a*) 3 1/4 % per annum £

ESTIMATED REDUCTION IN BRANCH LINE EXPENDITURE

Maintenance of way and works and estate property.

Work undertaken by full time branch line staff :

Wages (details to be given by grades)

Materials

Other Expenses :

Clothing

National insurance

Pensions

Other items

Per annum
£

Other work :

Permanent way — Renewals
Roads & fences — Repair & renewal
Bridges — Repair & renewal
Buildings — Repair & renewal
Signals, telegraphs and telephones — Repair & renewal
Other Items

Estimated reduction in expenditure on maintenance of way and works and estate property £

Maintenance of rolling stock and train working expenses (including guards).

Trains worked by engines, etc. employed full-time on branch

Repair and renewal of rolling stock :

Locomotives
Coaching vehicles
Other railway vehicles

Train working expenses :

Wages
Trainmen (including guards) (Details to be given by grades)
Other staff

Fuel
Water
Clothing
Stores
National insurance
Pensions
Other items

Other trains :

Engine, power
Guards' wages & clothing, national insurance and pensions
Maintenance of vehicles, etc.

Estimated reduction in expenditure on maintenance of rolling stock and train working expenses (including guards) £

Station, etc. expenses (excluding guards) :

Salaries and wages (Details to be given by grades)
Clothing
National insurance
Pensions
Station stores
Stationary, etc.
Lighting and heating
P. O. telephones
Other items — to be detailed

Estimated reduction in expenditure in Station, etc. expenses £

Per annum
£

Cartage expenses.

Cartage agents and hired cartage

R. E. Cartage units

Units employed full time on branch line cartage :

Repair & renewal of motor vehicles, etc.
Wages of drivers, etc.
Clothing
National insurance
Pensions
Other items

Other units

Estimated reduction in expenditure on branch line cartage £

ESTIMATED COST OF PROVIDING RAILWAY EXECUTIVE ROAD SERVICES IN LIEU OF RAIL SERVICES

R. E. units to be employed full time :

Repair & renewal of motor vehicles, etc.
Wages of drivers, etc.
Clothing
National insurance
Pensions
Other items

Assistance by other R. E. Units

Cartage agents or hired cartage (R.H.E. or independent hauliers) Total £

Estimated additional cartage revenue per annum : £

Passenger train traffic
Freight train traffic

£

ESTIMATED VARIATION IN NUMBER OF STAFF

	Department	Grade	Number	Standard rate of pay per week (or per annum)
Estimated number of full time posts to be effectively saved	(Details to be given by individual grades)			
Estimated additional full time posts required				
Anticipated re-grading of posts.				

ESTIMATED VARIATION IN UNITS OF ROLLING STOCK

Estimated number of units to be effectively saved

		Locomotives	Rail motor vehicles	Coaching vehicles	Other rail vehicles	Road motor vehicles
Number						
Type						
Class						
Estimated original cost :	£			(Details to be given for each type)		
Estimated replacement cost :						
Gross	£					
Net	£					

Estimated number of full time units of cartage equipment to be provided for R. E. road services in lieu of rail services :

Number		
Type		
Estimated replacement cost :		(Details to be given for each type)
Gross	£	
Net	£	

THE RAILW

. . . . . .

. . . . . .

NATURE OF TRAFFIC (1)	Traffic local to branch line						Throu	
	Proportion conveyed by rail (2)		Proportion carried by Zonal C. & D. services (3)		Total Cols. (2) + (3) (4)		Forwarded (5)	
		Amount		Amount		Amount		Amoun
Passenger train traffic	*Number of passenger journeys*	£		£	*Number of passenger journeys*	£	*Number of passenger journeys*	£
Passengers- ordinary and workman			—	—				
Season tickets			—	—				
Parcels and other merchandise by passenger train	*Number*		*Number*		*Number*		*Number*	
Total								
Goods train traffic	*Tons*		*Tons*		*Tons*		*Tons*	
Merchandise and minerals (excluding classes 1-6)								
Merchandise and minerals (classes 1-6)								
Coal, coke and patent fuel.								
Livestock	*Wagons*		*Wagons* —	—	*Wagons*		*Wagons* —	
Total	—		—		—		—	
Total traffic receipts	—		—		—		—	

Miscellaneous receipts, rents, etc.

	Amount £
Estate rents	
Warehouse rents	
Cloakroom	
Extra cartage	
Other items (to be detailed)	
	£

CUTIVE
ION
NCH LINE YEAR....

c				Total traffic receipts Cols. (4) + (7)		Estimated of gross receipts to Railway Executive if proposals adopted					
Received		Total Cols. (5) + (6)				Local traffic		Through traffic (	o)	Total Cols. (9) + (10)	
(6)		(7)		(8)		(9)		(10)		(11)	
	Amount		Amount		Amount		Amount		Amount		Amount
umber of senger rneys	£	*Number of passenger journeys*	£	*Number of passenger journeys*	£	*Number fo passenger journeys*	£	*Number of passenger journeys*	£	*Number of passenger journeys*	£
umber		*Number*		*Number*		*Number*		*Number*		*Number*	
Tons		*Tons*		*Tons*		*Tons*		*Tons*		*Tons*	
agons		*Wagons*		*Wagons*		*Wagons*		*Wagons*		*Wagons*	
—		—		—		—		—		—	
—		—		—		—		—		—	

Notes (*a*) The figures to include the junction station for branch line local traffic. (*b*) |o Similar information be given for through-through traffic where applicable. (*c*) For branch line local traffic « forwarded » traffic to be included.

VII. Construction of new railway facilities, lines, etc.

In the foregoing the question was treated of the total or partial closing down or withdrawal of railway facilities so as to adapt the transport system to lasting changes in the character, scope, and geographic distribution of the demand for transport services. Such measures are generally motivated by factual conditions: the traffic volume on the relevant line, or the use of the relevant facility has, when the measures are taken, usually decreased to such a degree that total or partial closing down of the line or facility offers the best solution. As regards such adaptation measures as involve an extension of the railway network by new lines or other facilities, the estimation will usually be more complicated. The measures must be based on consideration both of the factual extent, nature, and geographic character of the existing or anticipated demand for transport services, and of the probable future development of that demand. Most railway networks, as pointed out in the foregoing, were built up during a period when railways in many cases constituted the only means of transport that might come into question for long-distance land transportation. This fact influenced the shaping of railway networks and led to the construction of lines which, if the alternative means of transport now available had then been present, in many cases would not have come about or would not have been so extensive. Since the present major national railway networks originated to a large extent through the amalgamation of a large number of railway lines, built by different private or State enterprises, the extent, constructional standards, and operating scope of the lines frequently came to be determined by the special technical and economic conditions of each individual line. Hence no great consideration was usually given to the influence of the various lines on the economy of the network as a whole.

Modern planning of a new railway line, on the contrary, must take into account other possibilities of solving the current transportation problem and the influence of the new construction on the network as a whole. Since the chief competing alternative to railways in land transportation, namely, road motor traffic — particularly where it concerns transportation in sparsely populated areas and other cases where lighter traffic can be expected — may often afford virtually the same technical transport facilities as railway operation, a rational choice between them, would in most cases be determined purely on considerations of transport economy. For, given the premises in question, the cases in which the purely technical and practical advantages of railways compared with road traffic would exclude choice of the latter are, in most countries, probably very few. Nowadays it is not usually a question of establishing new and *longer* routes, but merely of implementing an existing network of communications with relatively short lines. From the standpoint of transport economy alone, the choice of transport facilities designed to meet a new or expected demand of a certain magnitude and structure would be determined by what type of facility would, at a given transport standard, be able to execute the transports most cheaply.

However, as in the case of closing down railway facilities, considerations of business economy alone probably are seldom the determining factor in the construction of new railway lines; rather the decision will also be influenced in most countries — especially those with State — owned or controlled railways — by considerations of social-economic, social, political, military, or other factors. Such considerations with no bearing on business economy may sometimes lead to commitments for the railway enterprise through which it will be obliged to execute transport assignments resulting in an economic net loss. So far as the writer is aware there are only a few cases in which a railway enterprise has been recompensed by the State for net

losses sustained as a result of such transport assignments not motivated by business economy.

Today it is usually the need of freight transports that necessitates plans for the construction of new railway lines. Since, as mentioned above, a number of different factors influence the profitability of a railway project, it is usually impossible to lay down any generally valid minimum traffic intensity required if that project is to be profitable. This minimum varies greatly according to the circumstances in each individual case, and as a rule each case must therefore be considered on its own merits. Yet it should be possible, under certain simplified premises, to lay down certain « rules of thumb » as to the minimum traffic density required.

In addition to the considerations treated e. g. Chapter VI C regarding such basis conditions for estimating the profitability of a new line as the probable future volume of traffic at various possible tariff levels, and the resultant costs of establishing and operating the traffic, it should further be stressed here that considerable importance may attach in this connection to the composition of different commodities carried and to the influence of a new line on the existing railway system.

With a system of tariffs based on the value of commodities carried, the minimum traffic density necessary to attain profitability of a new railway line would therefore have to be greater, if the anticipated traffic consisted of low-value commodities, raw materials, etc., than if it were composed of high-value commodities for which higher tariffs could be applied. Furthermore, if higher tariffs could be applied, at least temporarily, on the new line than on the rest of the railway system, the traffic density required for profitability would be correspondingly lower.

In general the possibility of attaining profitable operation of a new line may be said to be greater according as increasingly differentiated rates can be applied for passenger and freight traffic using the new line. Hence the general uniformity of tariffs throughout a railway system, which today is very common with railway enterprises, will often render difficult what would otherwise be a practicable expansion and implementation of the railway system with new lines.

When the new railway line is projected to implement an existing railway system, consideration must also be given to the additional and subtractive revenues and costs that will occur on other lines of the system through the establishment of the new line in question. Additional revenues may arise through transference to the railways of traffic previously transported by road or by waterway; or because, as a result of the new line, traffic in the latter's area, which previously went by rail to or from stations on the old system, will now use the stations on the new line, which thus implies longer railway transports than before; or, lastly, because the new line may stimulate production and traffic in general. Losses in revenues (subtractive revenues) may arise if the new line leads to a shortening of the transport routes of existing traffic on the railway system; and since the railways usually calculate the freight and passenger charges on the basis of distance tariffs and of the shortest distance geographically between origin and destination, substantial revenue losses may thus be the result in certain cases.

In a similar way and for similar reasons, additional costs and subtractive costs (savings in costs) may occur on other lines of the railway system through the establishment of a new line. Since these questions have already been treated in Chapter VI/C concerning different calculation problems, they can be disregarded here.

Some railways have made estimates of the probable minimum traffic density under average conditions in their countries that would render a new line profitable. They all stress that such an estimate, by the very nature of the problem, must of

necessity be very rough. According to the Finnish State Railways 500 000 ton-kilometres per kilometre of line is, at a rough estimate, the minimum tonnage for profitability of a new railway line. British Railways consider it impossible to lay down any hard and fast rule as to the minimum tonnage required to justify a new line, but on one recently authorised colliery line the anticipated tonnage varied from 500 000 tons a year initially to 1 000 000 tons a year ultimately. American experiences from the nineteen-twenties and 'thirties, earlier referred to in this report, indicate a minimum density of 250 000 ton-miles per mile of line.

On the basis of operating and traffic conditions in Sweden it has been estimated that if an isolated local freight traffic line is fully to cover its costs, it will require a minimum traffic density of about 400 000 ton-kilometres per kilometre of line.

Building of new facilities is nowadays undertaken by railways throughout the world for the purpose of expanding or modernizing their plant, replacing obsolete facilities. Developments in industry, new methods of distribution, and new forms of competition in transportation are bringing new problems in railway operation. Moreover, customers of the railways are demanding higher standards of service than before. All these changes, and shifts in the demand for railway transport services, necessitate various adaptation measures in railway operation methods, such as shorter schedules for freight and passenger trains, new designs for locomotives and cars, new methods of handling, collecting, and delivering freight, and many other improvements.

Such changes in operating methods and facilities have entailed a corresponding need for new facilities and for reconstruction of existing facilities which embraces practically all kinds of fixed property, including revision of alignment, passing sidings, yards, terminals, shops, power plants, locomotive-handling facilities, car-repair and maintenance facilities, inspection facilities, servicing facilities, fuel and sanding plants, water stations, offices, freight houses, station and other buildings, bridges, signals, and other structures and service facilities.

In reconstruction programs for the permanent way grade reductions and especially revisions of alignment to reduce or eliminate curvature, form important parts which are necessary to make possible high-speed passenger train operation. Changes in operating methods create a need for additional or extended passing sidings. In U. S. A. the introduction of centralized traffic control made such additional or extended passing sidings of major importance, as they were used in such a way that trains were not required to stop while the switching for meeting or passing trains were performed.

The time gained on the line haul by expediting the movement of trains between terminals may, however, be lost wholly or in part if the trains have to be handled in obsolete yards, designed for operating conditions that no longer exist. A very important item in railway reconstruction programs consists, therefore, in the yards and terminals for handling of traffic and for making up and dissolving trains. The rule is nowadays, in most countries, to try to make up trains at the originating terminal and send them through to destination with as little delay and further shunting en route as possible. In such « direct » or « through » trains, cars and traffic are set out and picked up at only a few stations at the most. Collecting and dispersing of cars and traffic to and from direct trains is performed by « way » or « local » trains. Such changes in train operating methods are necessary to make possible the higher standards of service now demanded by railway customers. Classification of freight cars is usually concentrated to strategic yards of the system. The economies of classification and train making accord-

ing to this system are especially important when the work is performed in modern mechanized yards, designed and adapted to the specific traffic needs in each case.

Such improvements of yards include rearrangement of tracks, new or revised humps, the installation of car retarders, interlockings and remotely controlled switches, yard lighting, communication systems of several types, and rearrangement of offices. In some cases it may even become necessary to build completely new plants with the devices just mentioned and many other features, such as weighing, inspection, icing, car-repair, and engine-handling facilities.

The Finnish State Railways have built 138 km of line during the last few years, and have under construction or are planning a further 387 km. The main reasons for the construction or planning of these new lines lie in the need of connecting links and complement lines to the railway system, and of access to new raw material areas for the wood and pulp industries.

A small number of new lines have been built by *British Railways* during the last few years to meet expanding industrial needs and increased output from certain collieries.

In *India* about 355 route miles of railways have been constructed and opened to traffic since 1947. These lines have been built to open up rich forest, mineral, and agricultural resources, to develop new regions, etc. In addition, 252 miles of line are under construction and it has been decided to commence work on the construction of another 47 miles of new lines and the restoration of 312 miles of railway lines dismantled during the last war.

In *Norway* the rebuilding of narrow-gauge lines to normal gauge and other modernization of existing lines (second track, etc.) are under way. New lines with a total length of 238 km are also under construction.

In *U. S. A.* the construction of new lines, spurred by the need for new resources of minerals and iron ore, has risen considerably during the last few years, and in the Review and Outlook Number of *Railway Age*, 1951, it was reported that « unusual activity is noted in the construction of new lines ». A larger mileage of new road was completed in the United States in 1951 than in the year before. Although the total of 129 miles constructed in the United States in 1951 is small in comparison with that built during the « expansion » era, it has been exceeded only twice since 1932 — in 1937 and 1947. No large lines were completed in 1951 but some of the trackage laid was part of longer lines under construction. Whereas much of the new trackage constructed in U. S. A. in recent years has been incident to relocation work of one kind or another, and therefore does not represent a net increase in the railway mileage of the country, most of that built during 1951 represents original construction.

In *Canada* a total of 55 miles of new lines was built, compared with 9 miles in 1950 and 39 miles in 1949. Enhancing the prospect of activity in the construction of new lines continuing in 1952 and later, is the fact that about 135 miles of new line are now under construction in U. S. A. and 513 miles in Canada (1).

In *Sweden* no new lines have been constructed during the past few years. Apart from a railway opened in 1940, which was commenced under private initiative but completed by the State, the last State Railway line to be constructed was completed in 1937, since when the State Railways have not taken any initiative with regard to the establishment of new lines. On the other hand, several projects have been discussed and investigated both on State and on private initiative, though nothing has yet been decided. These projects together comprise about 1 600 km of line

(1) *Railway Age*, No. 2, 1952.

and, at the prevailing prices and wage levels, would necessitate an initial outlay aggregating at least 500 million crowns.

The principal motive for bringing up these railway projects is that the establishment of railways would contribute to the development and differentiation of economic life in the relevant region.

Financial balances in respect of some of these projects are tabulated in the adjacent table.

In countries both ancient and modern, both tropical and northerly, railways are still often constructed to make possible the exploitation of new sources of raw materials. Such a railway project, of interest in many respects, is the Quebec, North Shore and Labrador Railway (1).

This new 360-mile railroad is now being constructed in the wilderness of north-eastern Canada to bring out the rich iron ore reserves of that region to steel mills in U. S. A. The ore supplies in the Mesabi Range of Minnesota are dwindling and iron ore from north-eastern Canada will now fill the need of steel for international defence and construction programs.

The construction of the railway from Seven Islands at the Gulf of St. Lawrence to Knob Lake in northern Quebec will take three years and involves the construction of many miles of passing track, a classification and dumping yard nearly two miles long, a new dock on the St. Lawrence, handling equipment at both ends, two town sites, two hydro-electric power projects, and other facilities.

To get the railway completed within the scheduled time of three years it has been necessary to carry on work at both ends and at intermediate points. When starting this construction work the only way to get equipment supplies and men into this uninhabited wilderness was by tractor sled during the winter and by « airlift » during the summer.

(1) *The Highway Magazine*, October, 1951.

LINE	Estimate made by	Length of line in kilometres	Construction costs	Operating revenues	Operating costs (1)	Profit or loss	Year (Price level)
		Millions of crowns					
Nyland-Umeå . . (Örnsköldsvik-Umeå)	Railways Board	224	54	2.3	2.1	0.2	1938
		89	45	2.7	2.1	0.6	1948
Umea-Byske .	Private interests	175	40	2.3	1.8	0.5	1948
Meselefors-Nordmaling		185	20	0.2	1.4	— 1.2	1946
Ljusdal-Norwegian frontier		200	38	0.7	1.9	— 1.2	1947
Sunne-Slättene . .	Government Committee	130	22	0.4	1.0	— 0.6	1949
Rada-Sundhultsmon .	»	100	17	0.3	0.8	0.5	1949
Valdemarsvik-Alem	Private interests	185	36	1.9	1.6	0.3	1947-48

(1) Excluding interest on capital outlay.

The railway will be single track, with mile-long passing tracks at 30-mile intervals. For the main track, 132-pound rails will be used, with 100-pound rails for sidings and yard tracks. Creosoted hardwood ties will be brought in by boat for half the track. The remaining 50 % will be spruce, obtained locally and treated with a preservative. Maximum gradient southbound (loaded trains) will be 0.4 %. Northbound, it will be 2 %. Maximum curvature will be 8°. A locomotive shop for maintaining 53 diesel-electric locomotive units, and car shops for maintaining 2 000 solid bottom ore cars, will be constructed at Seven Islands.

The iron ore lies in deep beds under shallow cover in the Knob Lake area. It will be mined by open-pit methods and loaded by 8-cubic yard power shovels into 30-cubic yard tracks or into belt conveyors for transportation to hoppers at the Knob Lake terminal.

Mining will be a six-months' operation and will probably be carried on largely by labour which now is engaged in lumbering during the winter months. Ore output is expected to be 5 million tons a year.

The railway will run about five radio-controlled trains daily, each hauling 10 000 tons in 100 cars. Trains will be drawn by four 1 600-H.P. diesel-electric units to Seven Islands, where the ore will be unloaded into stock piles at the dock and then reloaded in ore boats. Storage facilities at Seven Islands will permit boats to haul after cold weather shuts down the mines.

As pointed out already, an investigation into new communication routes nowadays cannot envisage railways alone; the possibility must be considered of using road traffic in certain cases, at lesser costs. In such cases, when a rail and a road alternative or a combined rail-road alternative is reckoned with, it will often be difficult to attain complete uniformity of standard between the various alternatives. Disregarding any possible differences in the tariffs applied in respect of road transport as a substitute for rail transport, the various alternatives present other peculiarities that make comparisons difficult. This may be illustrated by the following example from a Swedish investigation. It was estimated that the volume of freight on a projected railway would amount to 210 000 tons per annum, whereas a truck service that was envisaged in place of the relevant line would be able to count on a freight volume of only 100 000 tons per year. Of the freight volume referable to railway traffic it was estimated that 25 % would result from more advantageous routing in the railway alternative; 30 % would comprise such freight as would be unsuitable for road transportation or which might be counted on, with great probability, through the increase in production resulting from the advent of the railway line; and the remaining 45 % would comprise freight of the last-named character which could be anticipated, with some probability, in the railway alternative but which was quite ruled out in the road alternative.

Although in the above case it was estimated that the railway alternative would result in higher costs for the public than the road alternative, some doubt was nevertheless felt as to whether the latter should be chosen. For the truck route was not considered to afford the same possibilities as a railway of creating in the relevant area the requisites for increased output and for a more differentiated economic life.

Such differences with regard to transport cost are more conspicuous in freight than in passenger traffic. If we disregard certain cases bearing upon the growth of major agglomerations, the establishment of a new route of the type in question here probably would seldom come into question purely as the result of a greater demand for passenger transport facilities. In general such a demand probably would not be greater at the outset than could be covered by the introduction of relatively small

units. Moreover, the bulk of passenger transports in most cases would probably have a local character and hence would be carried out over relatively short distances. Generally speaking, if the new route consists of railway it will, therefore, not be a question, from the outset, of through trains or cars via the junction to the rest of the railway system, but merely of light rail units confined to the new line. Depending on the trend of population development in the zone which the new route was designed to serve, the situation might of course change by degrees. Yet even a very substantial increase of population in the new traffic zone would not necessarily entail an appreciable increase in the passenger transport facilities required on the new route. If the population should be concentrated, for example, in the immediate neighbourhood of a factory or a source of raw materials, the new means of communication would not have to cope with an excessive amount of traffic.

Hence with regard to *passenger transport* on a new route — if we disregard cases in which major centers of population spring up — the technical requisites for coping with the traffic should in general be about the same for the rail and the road alternative.

But, as regards the technical requisites for coping with *freight traffic*, the conditions may assume very different aspects for the two alternatives, due to the nature and quantity of freight, the distribution in time, the distance of transport, etc. Probably a new freight transport route is seldom required for purely local purposes; in most cases the motive lies rather in a desire to link up an unexploited or incompletely exploited zone with other areas and markets, perhaps located at a considerable distance. Even if road traffic facilities nowadays have, from the purely technical point of view, in many respects the same possibilities of transporting many types of freight — though more seldom with regard to long-distance bulk freight proper — it will nevertheless be more advantageous from the standpoint of transport economy to employ rail transport over a certain limit, varying with the volume and structure of the traffic and its distribution in time and space, etc. These questions have been treated in greater detail in Chapter V, to which reference should be made in this connection.

In the economically rational planning of a new transport line it does not suffice merely to consider a purely rail or purely road alternative; various combinations of rail-road alternatives must also be investigated. According to the special conditions in each individual instance, it may thus be necessary to investigate rail alternatives, ranging from full passenger and freight traffic to and from a number of stations, to traffic on industrial lines alone under simple forms. For the same reason the road alternative for its part may vary between full passenger and freight traffic on a ramified network, and freight or passenger traffic on a single route. Lastly, various combinations of the aforementioned rail and road alternatives may come into question.

In recent years the question of road motor traffic as a substitute for rail traffic in the more sparsely populated northern parts of Sweden has been discussed and investigated in various connections.

When it has been a question of expanding traffic communications in such an area, the view has usually prevailed that the existing demand should be met by railway facilities. Such views are indeed quite natural when we consider the advantages afforded by railway communications; for railways have played, for over a century, a dominant pioneering role in economic development and expansion. Moreover, the establishment of a railway probably is still considered to provide a better guarantee of well-ordered traffic communications than are other means of transportation. In many cases rail transport offers the only conceivable solution to a traffic

problem, for example with regard to heavy traffic such as iron ore. In other cases it is possible to choose between railway and road traffic, while in others again road motor traffic alone can come into question. In many traffic areas in northern Sweden the economic requisites for the establishment of a railway are lacking.

The special committee that examined, in the mid-nineteen-fourties, the possibility of improving transportation conditions in northern Sweden, investigated whether, in cases where the economic requisites for establishing a railway were nonexistent, some means of communication could not be arranged in any case on the following basis: at the same time as any loss on the operations would be less for the public than if a railway had been established, this communication would nevertheless be able to meet the same demand as would a railway. On this assumption the committee reached the conclusion that road trunk lines should be arranged on certain routes in northern Sweden. The aim was to meet the requirements of areas where, on account e.g. of the economic conditions, direct linkage with the railway network was justified, but where a railway could not be assumed to be practicable in view of the relatively small traffic volume and the operating losses that would probably be sustained. It was considered that the traffic on these road trunk lines, which might be described as a substitute for railways, should be operated either by the State Railways or by contractors. The State Railways, however, in their capacity of railway owners, should under any circumstances assume the responsibility for the traffic in question. From the points along these road traffic routes, freight could be conveyed to any railway station, and vice versa. In other respects the road services should be subject to the same regulations as the railway traffic. According to the committee's proposals, railway rates would apply in principle to the carriage of freight on these road trunk lines. Combined road-rail freight traffic would be subject, moreover, to through rates based on the rate system of the railways. Lastly, passenger traffic on road trunk lines, both local and through traffic, would be subject to the passenger fares charged by the State Railways.

The establishment of road trunk lines would — as in the case of railways — be subject in each special case to the consideration of the Government and Riksdag.

The establishment of such lines requires, in comparison with that of railways, relatively modest outlays. Incidentally these outlays, even if a railway should be established later, will not be altogether wasted, since the rolling stock can be used on other road services operated by the State Railways. Moreover, experimental road trunk lines serve to reveal the volume and character of traffic in the relevant area, and hence to facilitate a reliable appraisal of the need for a railway establishment and of the economic requisites for operating it. In the committee's opinion a further, and not insignificant, advantage of the establishment of road trunk lines is that the traffic can start almost immediately and without any appreciable delay meet the demand for regular communications. The construction of a railway, on the other hand, requires prolonged preparatory measures and is very time-consuming, at the same time calling for substantially greater volumes of material and labour.

If the road trunk lines are to be capable of fulfilling that task as a substitute for railways which the committee envisaged, the roads used by them must of necessity be of a high standard and suited for heavy traffic. This brings up the question of maximum permissible wheel load. For traffic with a comfortable long-distance bus seating about thirty passengers and of the modern Swedish design, a wheel load of at least three tons and a total weight of ten to twelve tons can be reckoned with. Such wheel loads are likely to be sanctioned only on certain parts of the relevant

road network. With freight traffic, however, even greater demands are made on the nature of the highways than in the case of passenger traffic. The main roads, it was considered, should have a technical standard making possible a maximum wheel load of 3 1/2 tons and the use of larger transport units. Whereas wheel loads of around three tons should give a load capacity of about 16-18 tons, an increase of the pressure to 3 1/2 tons for bogie vehicles might enable the total load capacity of a transport unit consisting of truck and trailer to be increased to 21-22 tons, and of a semi-trailer to something like 20 tons. The load capacity can be further raised by coupling yet another trailer.

A road trunk line of the type proposed by the committee has existed since the early nineteen-thirties; namely, that operated by the State Railways between Övertornea and Pajala. This line, with a total route length of 116 km, has the same status and character as a railway line and forms a direct continuation of the railway between Karungi and Övertorneå. This identity of status is due to the fact that the road line originally came about as a substitute for railway. The State Railways Board, in an inquiry ordered by the Government in 1925 concerning the establishment of a railway from Övertorneå northwards, had demonstrated that the economic requisites to make such a railway pay were lacking. A further inquiry in 1927 regarding the establishment of a road trunk line in place of a railway, showed that a road line would be substantially cheaper than a railway both in initial outlay and in operating costs. The estimate of traffic and receipts was made on the assumption that the State Railways' tariffs would be applied and that, in the event of combined rail-road transport, through rates would be employed.

The calculations showed that the road trunk line under these conditions would be run at a loss. The annual loss would be considerably lower, however, with road than with rail transportation. The establishment of the road trunk line from Övertorneå to Pajala was resolved upon at the 1929 session of the Riksdag, and the service was opened for general freight and passenger traffics in July, 1931.

The rates and general regulations for the traffic on this road service are identical with those of the State Railways. Conveyance is subject to the Railway Carriers Act and, when required, to the international conventions for conveyance by rail. Freight can be dipatched to and from the road service in the form of express, parcel, fast, or regular freight.

In traffic between points on this road route and State Railway stations, freight rates and passenger fares are calculated according to through distance and usual railway tariff.

The economic result of the operation of this road trunk line for the years 1938, 1945, and 1950 is given below:

YEAR	Traffic revenues	Operation expenses	Net operation loss
	Crowns in thousands		
1938	127	280	123
1945	336	805	469
1950	544	1 072	528

This combined road-rail traffic is of relatively great economic significance for the road trunk line, and its revenues from the through shipments of freight amount to between 60 and 70 % of the total freight traffic revenues.

The composition of this through traffic with regard to mode of conveyance and transports to and from the road trunk line is shown in the following tabulation, which relates to 1946.

	Freight in tons	Revenues in crowns
Parcel freight	65	4 429
Fast merchandise freight :		
to the road trunk line	160	4 212
from the road trunk line	112	2 245
Fast carload freight :		
to the road trunk line	54	526
from the road trunk line	23	189
Regular merchandise freight in shipments not exceeding 55 kg and with charges prepaid	557	7 090
Regular merchandise freight :		
to the road trunk line	1 617	24 463
from the road trunk line	514	7 523
Regular carload freight :		
to the road trunk line	11 718	49 083
from the road trunk line	368	9 318
Total	15 188	109 078

It is evident from the tabulation that no less than 94 % of the freight in this combined traffic consisted of regular freight shipments (including 80 % carload freight), corresponding in receipts to 83 % (carload freight 54 %). The large proportion of carload freight in the combined traffic is worthy of note. The mean weight per carload amounts to 10 tons; a carload on the railway often produces two to three truck loads. The traffic *to* the road trunk line predominates; only 20 % of the combined freight traffic consists of transports *from* places on the road trunk line to railway stations. The types of freight occurring on the road trunk line mainly consist of foodstuffs, agricultural supplies and products, and building materials. The bulk of the freight is conveyed to and from the terminus of the road trunk line (Pajala). Characteristic of this combined freight traffic are the long-distance transports.

To illustrate the profitability of freight and passenger traffic on the road trunk line between Övertorneå and Pajala, the respective revenues and expenses for 1946 are tabulated below :

	Passenger traffic	Freight traffic	Total
	Crowns in thousands		
Revenues	153	179	332
Operation expenses	197	685	882
Net operation loss	44	506	550

It emerges from the above that the great bulk of the net operation loss (92 %) is referable to the freight traffic. If ordinary road bus and road truck charges had been applied on the road trunk line instead of railway rates and through road-rail fares, the revenues of the road trunk line would have substantially increased, namely from 153 to about 210 thousand crowns in passenger traffic and from 179 to about 330 thousand crowns in freight traffic. The net loss of the operation would then have been reduced to about 250 thousand crowns instead of 550 thousand crowns.

The reasons why the revenues from traffic on a road trunk line in sparsely populated regions cannot cover the expenses when the rates and regulations valid for the railway lines are applied, are manifold. Suffice to mention some of the principal ones here.

The road trunk lines proposed by the committee run, like that between Övertorneå and Pajala, from a railway station towards more or less desolate highland communities. If a road trunk line is to fulfil fairly satisfactorily the same functions as a railway line, then relatively frequent passenger services must be maintained. This requires not only a service from the periphery to the railway station in the morning and a return service in the evening, but also a mail service from the station on arrival of the morning trains and to the station in the evening. Since the regions in question here are sparsely populated and the standard of living in general low, the passenger density will be too low for traffic of this scale. Hence the services must often carry but few passengers; on Saturdays the vehicles will be at best full, whereas the number of passengers on ordinary week days is very small.

The freight traffic on such lines is in general one-way. Supplies arrive by rail to be forwarded to the territory covered by the line, but from that territory there are only very few consignments of empties, fish and — when in season — berries. The traffic from the railway station is usually so small that one truck service every other day would suffice; but the population demand a daily service. If the traffic is of such magnitude that it cannot be covered by a daily service, but instead requires extra services, the economic result will scarcely be improved, since every ton carried causes a loss to the line, the transport charges being low and the truck having to run empty in one direction.

The road trunk lines are designed for areas with long and cold winters where the roads are hilly and frequently difficult to traverse, due to snow-drifts in the winter and loose surfaces in the autumn and spring.

The climate and the unsatisfactory road conditions serve in many ways to increase the costs of road services. Garaging expenses here are higher than elsewhere, partly because more expensive buildings must be erected and partly because of higher costs of heating. Heavier, and hence more expensive, vehicles must be used in traffic; the fuel consumption is high on these hilly and badly surfaced roads; the wear and tear on tyres and engines is greater than normal, etc. Moreover, on these roads the speed must be lower than normal, this prolonging the hours of duty of the staff. All these factors contribute to make operations expensive on road services in regions of this kind.

In order that road traffic in these areas may cover its expenses, it is essential from the standpoint of business economy — unless the traffic can be subsidized — to restrict it so that it will meet only the minimum requirements of the places served, and to apply somewhat higher passenger fares and freight rates than those valid in the more densely populated parts of the country. It should be fairly evident, therefore, that in maintaining relatively frequent services and applying substantially lower fares and rates than those valid for lines operating under the most favourable conditions, a substantial loss is bound to be incurred.

The road trunk lines in question in northern Sweden have not yet been esta-

blished. When the State Railways Board made its pronouncement on the relevant proposal it pointed out, that from the standpoint of business economy the advisability of applying railway charges both for passenger and, above all, for freight traffic on such lines was very questionable. For the railways' freight charges were, in respect of virtually all consignments, considerably lower than the freight charges applied for ordinary road truck traffic. In view of the fundamental differences in the structure of costs that exist between railway and road traffic, and since the application of railway rates in the local and coordinated service of the road trunk lines might be expected to result in substantial operating losses, the State Railways Board rejected the use of railway tariffs on the road trunk lines, as well as the application of through fares in combined traffic. If Government and Riksdag nevertheless felt that railway tariffs should be applied to the road trunk lines, then the State Railways as a business undertaking ought to be recompensed for operating losses by government subsidies.

A. — *Planning of an efficient and properly integrated transportation system.*

In Chapter VI, part F, of this report it has been stressed that the problem of establishing an efficient transportation system in a region or in a country is not one of choosing between this or that means of transport, but rather of ensuring, through a flexible combination of different transportation means and facilities, the most efficient transportation service under different circumstances at the lowest possible total real cost to the community. The achievement of such an efficient transportation system is complicated by the fact that in most countries the transportation industry consists of a large number of more or less independent, specialized single-type enterprises, using only one type of transport, rail, road, water, etc., and that governments seldom permit multiple-type transportation enterprises, using all available types of transports, to operate. It is a general experience that the same degree of efficiency and economy of service cannot be obtained through the arrangement of joint service by separate and competing types of transport enterprises. One proposed means of securing an efficient transportation system, which nowadays has many spokesmen, is that the present mode of carriage and transportation by specialized enterprises for rail, road, water, air, etc., should be abandoned and replaced by transportation enterprises with access to and using different available technical transport means (transportation companies).

The development of a transport policy aiming at an efficient transportation system, including coordination of the various types of transport, maximum efficiency in organization and operation of each individual enterprise, will be considerably less difficult in undeveloped areas or countries, where one can start building up the system from the beginning, than in older, more highly developed areas or countries where vested interests in communities, investors, government agencies, etc., try to maintain the status quo.

The general principles for obtaining an efficient coordination of rail and road services have been discussed in Chapter VI, part F. In the following, attention will be given to these coordination problems in respect of undeveloped areas or countries, where it is usually easier to effect a rational solution than it is in the more highly developed ones. The planning of an efficient transportation system can, in such undeveloped areas, often proceed on much the same principles as those on which the business economy of an enterprise is based.

In undeveloped countries the establishment of an effective transportation system is often a primary requisite for broadening the economic base of the country and creating a better standard of living for its people. Thus a general survey mission to Cuba, organized by the International Bank

for Reconstruction and Development, in their Report of 1951 selected the following two projects as the most essential and the most likely to benefit Cuba as a whole :

« (1) Reorganization and rehabilitation of Cuba's public service railroads. »

« (2) Establishment of a Highway Advisory Committee to be responsible for the efficient maintenance and expansion of Cuba's highway system. »

Another mission of the International Bank to Guatemala in their report stressed the basic need for improved transportation finding « probably the greatest single barrier to Guatemala's economic development and cultural integration in the present inadequacy of her transportation system ».

The importance of efficient transportation for the economic development of different countries in Africa, and the problems arising in this connection, have been treated at length by Mr. R. J. HARRISON CHURCH (1).

Mr. HARRISON CHURCH stresses the importance of railways for economic development in Africa, and states that the efficient development of any area demands good transport at all seasons of the year, capable of carrying bulky commodities of low value at cheap rates, and that only railways can fulfil this function in Africa; although for less bulky commodities of higher value on short hauls, or in pioneer areas which cannot yet support a railway, road transport may be more effective. Rivers, too, may take the place of or supplement railways, but in Africa the rivers leave much to be desired. Where river transport thus is insufficient or totally lacking, railways and roads must be the main transport media. In such areas, railways were the main method of long distance all-season bulk transport at cheap rates until after World War I. Since then road transport has developed in coastal areas where profitable door-to-door transport of more valuable commodities over short distances was available, and also in pioneer areas where the traffic volume was insufficient to make railways profitable.

According to Mr. HARRISON CHURCH there was, between the wars, a disposition among some Powers in Africa (especially the British) to believe that road transport was more useful, but this was an unfortunate error. « Large-scale mining activities cannot be sustained without rail transport, as is demonstrated by the history of iron mining in Sierra Leone, gold mining in the Gold Coast, tin mining in Nigeria and the exploitation of the heavily mineralized zone of Katanga (Belgian Congo) and Northern Rhodesia. Similarly, the massive growth of groundnuts in northern Nigeria 700 miles or so from the coast, and of cotton in Uganda at a roughly similar distance, both depend very largely upon rail transport, and there are countless other examples. The British East African Scheme for the Mechanized Production of Groundnuts also depends upon efficient rail transport and it would be a wise precaution in the planning of all such large-scale agricultural (and mining) activities to plan for efficient rail transport from the beginning. »

The great era of railway construction in Africa was between 1885 and 1931 and especially between 1895 and 1914. Climatic and other geographic factors have made development of transportation and particularly of railways very difficult in Africa. The scattered and irrational population distribution has caused a corresponding uneven traffic distribution on the railway lines which gives rise to great operating and financial problems. Almost all the lengthy railways have long intermediate sections which are practically unproductive of traffic. As examples of such unproductive sections of railway lines the following are mentioned in Mr. HARRISON CHURCH's study : the Nigerian Western Railway, where very little local goods and

(1) « Geographical Factors in the Development of Transport in Africa », in *U. N. Transport and Communications Review*, Vol. II, No. 3, July-September, 1949.

passenger traffic is found from stations between Oshogbo, 182 miles from Lagos, and Zaria, 617 miles from Lagos; the Nigerian Eastern Railway, where practically no goods or passengers are found from the section between Enugu, 151 miles, and Kaffanchan Junction, 459 miles from Port Harcourt. Such examples could be multiplied throughout the tropical areas, but the condition is especially noticeable in West Africa. In other parts of the world, too, similar conditions are probably present in undeveloped regions or countries.

According to the study quoted, African railways have suffered severely from the fact that they were built rapidly and economically and often for strategic purposes. « This inheritance makes them difficult to work at a profit, yet it must not be assumed that because a railway runs at a loss it has no value, for on a railway may depend the general welfare of an area. Unfortunately, far too many African Railways have been bedevilled by politics. Each Power has sought to build its own line to keep trade within the territory and if possible to attract some from neighbours. Separate gauges have been deliberately chosen, so that there are now six main gauges in Africa. For practical purposes and on the most significant lines, however, the main gauges are standard European (many lines in Algeria, Tunisia, and Egypt); the 3 feet 6 inches gauge is used in South and Central Africa, the Anglo-Egyptian Sudan and on the Nigerian, Gold Coast, and some Egyptian lines; the metre gauge is used on the French Colonial railways and in East Africa. »

Nowadays, however, there is a tendency among the Powers to co-operate on transport matters. It is proposed in the future to convert the metre gauge railways of East Africa to 3 feet 6 inches gauge and to link them up with the railways of Central and South Africa by a line between Tanganyika and Northern Rhodesia.

Many of the African railway systems are now congested by traffic; vast quantities of agricultural products, uranium ore, copper, asbestos, rare metals, and all the needs of modern industry are transported over single-line routes.

This rapidly expanding traffic has entailed considerable additions and improvements to existing facilities. On some sections additional crossing stations have been brought into use to increase the train capacity of the section. Crossing loops are extended to enable longer trains to be run. To allow heavier engines to be employed, work is in progress on relaying sections with heavier rails.

Realignment schemes to allow of substantial increases in the loading of trains are being carried out.

New lines have been, and are being, constructed; the capacity of existing sections is being increased, and additional and improved facilities are steadily being provided at stations and ports. Much new construction is in progress or under consideration.

The problems as regards development of roads and road transport in Africa are about the same as for railways. The factors which made railways difficult and expensive to build in Africa make roads as expensive to build. Yet roads are often even more expensive than railways to maintain in areas of marked seasonal variation of rainfall and where the total rainfall is heavy.

As regards the relative importance of rail and road in an efficient, coordinated transportation system under such varying geographic and economic conditions as prevail in different parts of Africa, the following conclusions from the Harrison Church's study seem especially instructive: « As the roads have generally been built after the railways, and since the latter are often owned by the Administration and can produce revenue, it is not unnatural to find that roads which do not themselves produce *direct* revenue are conceived as feeders to the railways. If the railway is a reasonably efficient one, this may be a good policy, so long as areas far removed from railways are also adequately served

by road. Roads are important in pioneer areas, as they seek out and develop traffic. They are also essential in areas of dense population and along and near coasts. But it is profoundly true that they cannot anywhere in the world replace rail transport for cheap, all-season, bulk transport over great distances, and this is exceedingly true in Africa. »

« Although roads are subject to the same geographical factors in their construction as are railways (with the exception that water supplies are not required for road construction and maintenance), road transport is much more flexible and overcome geographical difficulties with greater ease (though not necessarily with less expense) than can rail transport. Roads can therefore be built with sharper curves and steeper gradients and can be gradually improved. Thus they can be more experimental (hence their value in pioneer country) and can be adapted more easily to geographical factors than can railways. »

As an interesting example of the complementary character of rail and road transport in many cases, it may be mentioned that petroleum necessary for road traffic in Africa has to be imported and much of its distribution is effected by railways, so that road transport depends, in this way, upon the railways.

The planning of an efficient transportation system in undeveloped areas or countries, where a start can be made from the very beginning, has been exhaustively and ably treated by M. P. BOURRIÈRES in his « Essai d'étude économique générale des voies de communication en pays neuf » *(Annales des ponts et chaussées,* 1950, No. 1-4). M. BOURRIÈRES primarily deals with the following main problem: What should a « profitable » transportation system, composed of various types of highways, railways, and (possibly) waterways be like in a colony if it is to make possible the exploitation of that colony's latent wealth over the greatest possible area. In determining the profitability the author postulates the State as an independent business enterprise.

The economic activity of exploited colonies is almost entirely directed towards foreign trade. The domestic turnover is negligible and the consumption largely consists of imports, except in the case of foodstuffs. The latter, however, do not require any large-scale transportation, since they are usually consumed at the places where they are produced. The active elements within the country consist of native and European producers and exporters. Manufacturing, which is but little developed, usually occurs only in respect of agricultural products, for the purpose of raising their quality or of reducing their weight and hence securing cheaper transportation. Of the above considerations the volume of exports may be regarded as an adequate criterion of the economic activity within the country.

A communication line established by the State may be said to be profitable if the receipts accruing to the State from the new (or improved) line are greater than the costs of establishing and operating it. The requisite for profitability may be expressed in the formula:

$$\Sigma q\ i + \Sigma q'\ (i - i') - K > 0$$

where q' denotes the quantity of products transported via the old communication line that is replaced;

q the quantity of new products attributable to the advent of the new communication line;

i' and i the old and the new « taxes », respectively, on the products in question, levied either directly or indirectly through the freight rates on the transportation system; and

K the constant (fixed) costs of the transportation system which are borne by the State out of State revenues (taxes, etc.).

By « taxes » (*impôt*) is meant any additional sum collected by the State over and above the marginal costs of the services

rendered by the State. When services are rendered at prices lower than the marginal costs, we may speak of subvention or « negative taxes », corresponding to the difference between marginal costs and prices.

M. Bourrières defines the utility (u) of public works as follows :

$$u = \Sigma q' (p' - p) + \Sigma q (v - p) - K$$

where p denotes the marginal costs and an apostrophe refers to conditions prior to the advent of the public works in question. The magnitude (v), called « the utility value of the service rendered » (*valeur d'usage du service rendu*), is the highest price that the user of the means of communication will pay.

According to the author this formula cannot be used in practice, since the value v is impossible to determine; it varies from one user to another and is largely dependent on the magnitudes q' and q. M. Bourrières seeks, however, to determine a more precise « utility criterion » in respect of the construction or improvement of communication lines in the colonies (pp. 57-60).

To facilitate the choice of one of several transportation projects and to make clear to the responsible political authorities the economic implications of different projects, the latter are classified in four main groups, namely :

R, directly profitable;

R′, indirectly profitable;

u, serving a useful purpose (« *utiles* ») but not profitable, and

i, serving no useful purpose (« *inutiles* ») and not profitable.

In determining the direct profitability of a communication line in the colonies M. Bourrières takes primarily the following State revenues or « taxes ».

1. Export duties on products attributable to the advent of the communication line.

2. « Taxes » (over and above marginal costs) on the new products resulting from the new communication line (« negative taxes » in the case of subventions).

3. Import duties on new imports — in which connection it should be borne in mind that in an exploited colony the volume of imports and exports respectively is approximately the same.

The increase in exports and the higher State revenues that may result from a new or improved communication line are often difficult to estimate. Nevertheless, certain estimates of the increased State revenues on various assumptions are made in M. Bourrières' study.

Other State revenues than the above increase, however, as a result of the rise in production (attributable to the new communication line) and hence contribute indirectly to an increase in the profitability of the new transportation line. These indirect revenues are as follows :

4. Taxes levied on physical persons (per capita), since the increased income of the native population makes possible a rise in this tax.

5. Taxes levied on businesses (though these are difficult to estimate).

6. Various taxes paid by consumers.

The above conception of profitability postulates, as mentioned already, that the State is an independent business enterprise whose interests collide with other economic interests within the community. However, the profitability (direct or indirect) in a welfare state will not generally be considered as an essential condition or sufficient reason for the construction of a public transportation line. Due regard must always be taken to the influence of the works in question on the economy of the private section of the community.

In Chapter II of the first part of the study an analysis is made of the constant costs (interest, amortization, and maintenance) in respect of different types of communications (roads, railways, waterways), which costs must first be elucidated before

any estimate can be made of the profitability of a new or improved communication line.

In Chapter III of the same part there is a study of how the marginal costs relating to transports on different types of communication lines are influenced by the latters' technical standard (grades and curves, strength of roads and bridges, road surfaces, weight of rails, etc.). The analysis of these costs does not take into account return load haulage of transportation vehicles, since traffic in undeveloped areas is in great part unbalanced, the vehicles going loaded in one direction and empty in the other.

Chapter IV includes an investigation of the increase in State revenues attribuable to new or improved communication lines in colonies. Such State revenues as contribute directly to the profitability of such public communication lines are mentioned above under points 1-3. In estimating the indirect profitability of public works, the State revenues mentioned in points 4-6 must also be taken into account. In M. Bourrières' study these indirect State revenues are tentatively estimated as a certain percentage of the total increase in the value of the country's exports.

B. — *Planning of a profitable network of communications enabling the greatest possible area to be exploited.*

The analysis of the main problem of how a rational system of traffic communications (composed of railways and various types of roads) should be built in a newly exploited region is done in Chapter V, being exemplified with data relating to conditions on the Ivory Coast. M. BOURRIÈRES approaches this problem on the assumption that the undermentioned categories of communication lines would be integral parts of the network.

CATEGORY	Initial outlay per kilometre (1938) in francs	
	Forest regions	Savanna regions
Tertiary road : width 4m; no terracing; temporary bridges .	10 000	2 000
Secondary road : width 6 m; maximum grade 8 %; maximum curve radius 100 m	30 000	20 000
Primary road : width 7 m; maximum grade 5 %; maximum curve radius 300-500 m	100 000	60 000 to 80 000
Railway : gauge 1 m; maximum grade 10 ‰; maximum curve radius 500 m	1 300 000	1 000 000

The constant costs per kilometre per annum in respect of interest, amortization, and maintenance are roughly estimated at the following amounts. (See table next page.)

The other data included in the estimate of the optimal composition of various types of communication lines are : first, the f.o.b. value (KE) of the production per sq. km available for export (largely dependent on climate and density of population) — of which value 50 % is assumed, in the cases treated by M. BOURRIÈRES, to accrue to the national exchequer in the form of duties and taxes; secondly, the marginal transportation costs (p, p', p'', and p''') per ton kilometre on various types of communication lines; and, thirdly, the transportation margin (a), i. e. the maximum transport

CATEGORY		Constant costs per kilometre per annum (1938) in francs	
		Forest region	Savanna region
Tertiary road	V =	1 000	500
Secondary road	D =	5 000	4 000
Primary road	N =	10 000	6 000 to 8 000
Railway	F	130 000	100 000

costs per ton which the exploited products might sustain. (M. Bourrières disregards costs of rehandling between different means of transportation, and this may be considered justified in colonies with cheap labour and substantial transport distances.)

M. Bourrières chiefly analyses the problem of the optimal traffic network for a region with « monoculture » (production of a single commodity) in which all products are transported to one port for exportation. In this connection a distinction can be made between two cases, namely :

A) The region that can be drained is unlimited with respect to transport potentialities;

B) The region is limited (for example, by political frontiers).

In case (A) M. Bourrières determines which traffic network composed of various types of communication lines, would make possible production over the greatest possible area, i. e., as far away from the exporting seaport as possible. In case (B) he examines the conditions essential if the State's profit is to be as great as possible.

The problems are further treated on the following alternative assumptions.

a) Complete absence of communication lines;

b) Existing railway.

Lastly, M. Bourrières deals with corresponding problems in respect of regions with « polyculture » (production of several commodities).

In the following, only case (A*a*), envisaging a (homogeneous) region with monoculture, will be treated, as a type example of M. Bourrières' mode of approach. The solution of the relevant problem of the economic optimum is illustrated by means of a schematic representation, reproduced hereafter as *Figure 17*.

The following designations are introduced :

l = average length of different tertiary roads;

l' = average length of different secondary roads;

l'' = average length of different primary roads;

l''' = average length of different railways;

$2\,d$ = average distance between two adjacent tertiary roads.

From this it follows — at all events approximately — that :

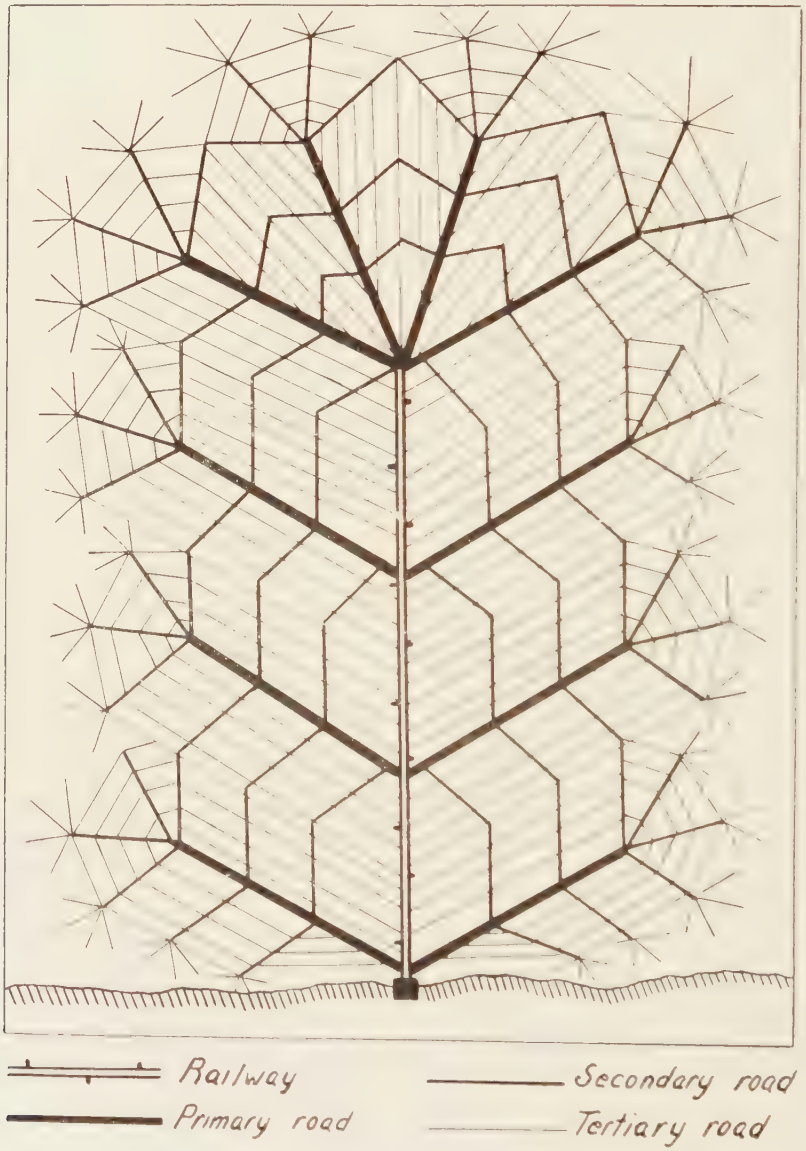
$2\,l$ = the average distance between two adjacent secondary roads;

$2\,l'$ = the average distance between primary roads.

The average annuity per sq. km in respect of the transportation system, corresponding to the constant costs for inte-

Figure 17

SCHEME OF TRANSPORTATION SYSTEM
IN A MONOCULTURE REGION SERVED BY A PORT



rest, amortization, and maintenance of the traffic network, will be approximately :

$$\frac{F}{2\,(l'' + l')} + \frac{N}{2\,l'} + \frac{D}{2\,l} + \frac{V}{2\,d}$$

On the assumption that this annuity corresponds to the profit for the State administration — which, as mentioned above, is presumed to constitute 50 % of the value of exports (KE) per sq. km — we obtain the following « profitability equation » :

$$\frac{F}{l'' + l'} + \frac{N}{l'} + \frac{D}{l} + \frac{V}{d} = KE$$

Further, the following equation is set forth, in which the marginal transportation cost in respect of products from regions with the most unfavourable locations is expressed as the equivalent of the transportation margin a :

$$p'''l''' + p''l'' + p'l' + pl + br - a = 0$$

where p, p', p'' and p''' denote the marginal transportation costs per ton kilometre on various types of transport lines; b denotes the distance, and r the transport cost per ton kilometre in respect of transportation from plantation to tertiary road (which transportation costs in the present case are assumed to be borne by the relevant producer alone).

M. Bourrières thereafter determines the values for the distances l, l', l'', and l''' that satisfy the aforementioned equations and which lead to a maximum value for the sum of $l' + l'' + l'''$, i.e., the extent of the exploited region counting from the exporting seaport. The solution given by M. Bourrières may be expressed as follows :

$$\frac{l}{\sqrt{\frac{D}{p}}} = \frac{l'}{\sqrt{\frac{N}{p' - p''}}} \quad \frac{l''}{\sqrt{\frac{F}{p'' - p'''}}} \quad \sqrt{\frac{N}{p' - p''}}$$

$$= \frac{\sqrt{Dp} + \sqrt{N\,(p' - p'')} + \sqrt{F\,(p'' - p''')}}{KE - \frac{V}{d}}$$

$$l''' = \frac{a - br - pl - p'\,l' - p''\,l''}{p'''}$$

It is evident from the above that in prosperous regions (relatively large KE) the solution of the optimum problem will consist in relatively short roads and penetration of the railway far inland. In an unprosperous region (relatively small KE) the solution will involve, on the contrary, transportation to the railway via relatively long roads.

To illustrate the order of magnitude of these contributory factors, figures are cited below exemplifying the state of affairs on the Ivory Coast in 1938.

Yield KE = 720 francs per sq. km per annum (value of exports).

Transportation margin a = 750 francs per ton.

Distance between tertiary roads $2\,d$ = 20 kilometres.

Marginal transportation cost :

		Francs per ton kilometre
From plantation to tertiary road.	(r)	30
Tertiary road	(p)	3
Secondary road	(p')	2
Primary road	(p'')	1.50
Railway	(p''')	0.25

Below are given the optimal distances in respect of various types of communication lines, calculated on the basis of the aforegoing data (savanna region) :

Tertiary road	l =	29 km
Secondary road	l' =	85 km
Primary road	l'' =	135 km
Railway	l''' =	1 100 km

In the optimum problem treated above, it is assumed that the constant costs in respect of the establishments would be borne by the national exchequer. The marginal transportation costs, on the other hand, constitute the transportation charges on the products, and no subvention is

postulated in respect of them. For various reasons there may, of course, be justification for the State to apply lower charges on the transportation system than the marginal costs, and thus to transportation consumers grant a subvention amounting to the difference between the marginal costs and the transportation charges applied. This problem, too, is taken up by M. BOURRIÈRES in his excellent study, which can be recommended both to engineers interested in rational transportation planning and to economists interested in price and production policies of public enterprises, location theory, etc.

VIII. Summary.

1. — The question of modifying an existing railway system by closing down old lines or by constructing new ones may be said to constitute one facet of the problem of keeping the transport services adapted to changes in the scope and nature of the demand on them. So far as the railways are concerned, such adaptation usually takes a considerable time.

The radical change in the scope and nature of this demand, which has now appeared in relation to the days when the railway systems in most countries assumed the structure as to number, course, and configuration of lines that they still have in the main; the advent of new means of transportation, automobiles, pipelines, electric power transmission, etc., which, besides fulfilling new requirements, also took over transport work previously executed by the railway; changes in the technical and economic structure and in the geographic distribution of production (urbanization and suburbanization; trends towards small- or large-scale production; substitution in production of new materials and products for older ones, etc.); and the mounting tendency to apply purely business-economical principles in determining the size and capacity of railway establishments — all these structural changes in economic life have necessitated a general supervision and adaptation of the various elements of the business policy of railways, e. g. policy on the closing down or construction of lines, stations and other facilities, or on rates and methods of production, etc.

2. — The planning of the location and course of the individual lines of a railway net was in almost every country made piece by piece and not coherently. The important changes in the structure of economic life and in transportation, mentioned in point 1, that have occurred since the railway systems in most countries were built out, have caused new conditions for the shaping of a rational transportation system.

Instead of the earlier planning piece by piece of the lines of a railway net the aim of the planning must now be to lay down the totally required traffic routes, i.e. the traffic net as a whole, of a region constituting an economic unit. Regions of various sizes can there be concerned, e.g. the transport routes within a city, or the routes within the influence area of a large agglomeration, within a large geographic region, or within a whole country. With respect to countries, this total planning of the traffic net will be applicable principally for undeveloped ones. But in countries with well developed economic life and railway system it may also be advantageous to adopt this aspect of planning traffic routes in their entirety with a view to finding out what is wrong with the existing net and how it could suitably be improved by constructing new lines or closing down existing ones. Such a revision and examination of the line planning is urgent both for countries where lines were built piece by piece without a comprehensive plan and for countries where, before starting the railway building, they drew up more or less detailed plans for a railway net embracing the whole country.

3. — The general supervision of the railways' economic structure in different respects must aim at determining which branches of the activity are unprofitable and by what means their profitability and

hence the railway company's economic position as a whole, could be improved. This aim might be briefly described as the accomplishment of a higher net revenue by effectivizing production and sales activities and concentrating them to a smaller number of more profitable sites of production, and more profitable categories of transport assignments, respectively. This supervision should embrace the following branches of activity :

a) The various *lines* in the network Here it may be a question of simplifying operations, or of partial or total closing down of the least profitable lines and the introduction of bus and truck services to complement or replace them.

b) The various *sites of production,* such as stations and other traffic establishments, engineering plants, stores, etc. Concentration of activities, or the total or partial closing down of certain centres of production, may often serve to improve the economic position as a whole.

c) The various *trains* in passenger and freight services. Modified train schedules, introduction of new train services, withdrawal of existing trains or changes in their length, replacing of certain train services by bus or truck services, etc. may also bring about a better economic position.

d) The various *cars* in passenger and freight services. The economic position may be improved, similarly, by changes in the types of cars, the introduction or withdrawal of through sleeping or passenger cars and through merchandise cars.

e) Needless to say, not all branches of traffic are equally remunerative for the railway company. The profitability may vary considerably for large and small consignments of merchandise and carload freight, and for irregular and regular assignments in freight traffic and journeys in passenger traffic. Likewise, journeys in passenger traffic and transports in freight traffic occurring during peak traffic periods, are naturally less profitable than those occurring during slack periods. By revising rate policy and undertaking changes in train schedules and types of cars, etc., it will often be possible to make different branches of passenger and freight services more profitable and hence improve the economic position of the company.

In conjunction with general supervision as outlined above, it is also important that matters relating to the standard of transport services be observed, so as to avoid providing a higher standard with regard to speed, etc. than is consistent, economically, with what the relevant transport user is prepared to pay. Within certain limits it is here a choice either of higher standard and higher prices or lower standard and lower prices.

4. — Both in general supervision of business policy as outlined above and in the more continuous control of business policy, adequate knowledge of expenditure and receipts, and the possibility of putting this knowledge into practice, are required. This in turn calls for various kinds of estimates of expenditures and receipts, partly for rationalization and the checking of operations, partly for the fixing of rates. Such calculations are necessary not only for the rational management of railways, but also for an intelligent policy designed to protect the railways' interests in relation to such institutions, etc. as influence the external conditions on which its economic life is based (government, parliament, economic associations of various types, press, radio, etc.).

The problem of rational calculations for the railways' business policy was treated at length at the Fifteenth session of the International Railway Congress Association in Rome, 1950 (Questions X and XII).

5. — The structural changes mentioned above which have occurred in the demand for transport services and in transport technique necessitate various adaptation measures respecting the number of lines, stations, etc., in the railway network, if the aim is

to bring about as rational a transport system as possible.

As regards regions with not unduly dense traffic, the transport requirements can probably be met in the best and cheapest way by a relatively open network of railways, maintained at a comparatively high technical and operational standard. The « mesh » of this network will be dependent, among other things, on the proportions of local, regional, and interregional traffic, and on the extent to which it is necessary or profitable to retain local traffic in the network. From the economic point of view this local traffic should mainly consist of road transport, which serves, too, as a means of collection and dispersal for the railways and which implements the railway network.

Due to the more efficient collection and dispersal of traffic to and from railway stations that has now been effected with the advent of road traffic, the economically optimal distance between railway stations has usually increased to a high degree. This has been manifested in a more marked concentration of traffic to a smaller number of stations. The mounting urbanization of economic life, etc. has contributed to this tendency to concentrate traffic.

In some cases an adaptation of the railway network in above respects to the changed conditions would probably presuppose the closing down or stripping of certain existent lines or stations, and the rehabilitation and refitting of other lines and stations. In certain cases the establishment of new lines and new stations (for collection or dispersal of traffic) or new switching yards, etc. may be justified. Use of road traffic coordinated with the railways as a supplement to and substitute for rail traffic might well reduce operating costs for the railways and ensure a higher transport standard for the people, notably in sparsely populated regions, due to the greater extent of the road network and the smaller operating units in road transport.

6. — It is primarily road competition that in all countries have reduced traffic on certain railway lines, especially branch lines, to such an extent as to necessitate total or partial discontinuing of railway service. But road motor transport has not had this negative significance alone; in all countries it has come into use as an important supplement to and substitute for railway operations. The railways' use of motor traffic as an instrument for rationalizing railway operations has often been delayed or rendered impossible, however, by existing laws prohibiting them from acquiring licences for the use of trucks, etc. Moreover, railways have often been compelled for social or other reasons to forego such measures as might have been desirable from the standpoint of business economy. Since the early nineteen-forties road transport competing with railways, has taken over such a large proportion of the traffic volume in certain sparsely populated regions in several countries that the total abandonment of operations on certain light traffic lines would have been economically justified. But since in many cases such measures would have required extensions of the road network or the acquisition of further vehicles — which under the prevailing economic conditions was usually impracticable — the responsible authorities usually refused to sanction the closing down of such light traffic lines. Total closing down and a transition to road transportation might also have been prevented or rendered difficult by opposition from such customers as have had typical railway freight and who have built up the whole of their activities accordingly.

7. — The various measures that might come into question when a railway line has lost all or part of its importance, yet still must face a certain demand and therefore take into account the possibilities of executing transport assignments by other means, are as follows :

1) Total and definitive closing down;

2) Partial closing down :

a) with respect to types of traffic;

b) with respect to time;

c) with respect to the magnitude and organization of the traffic system.

In certain cases various combinations of the above measures may come into question.

Partial closing down with respect to types of traffic may involve the withdrawal of all passenger or all freight traffic, or the transference e.g. of local passenger or freight traffic to other means of transportation.

Partial closing down with respect to time may involve the total withdrawal of all traffic during certain periods when the demand either abates or disappears on a seasonal basis or due to slumps. It may also involve retention of freight traffic but temporary suspension of passenger traffic.

Partial closing down with respect to the magnitude and organization of the traffic system may involve, for instance, the closing of certain stations and the concentration of traffic to a few centres of distribution or collection. It may also imply the withdrawal of traffic in certain limited areas, e. g. factory or quayside tracks belonging to a certain line.

The adaptation of a light traffic railway line to a progressively diminishing volume of traffic — a process that was common in most railway countries during the inter-war years — is generally characterized by a progressive reduction of operating and service standards, approximately as follows.

Continuous decrease in service, by reducing the number of trains, employing combined passenger and freight trains, maintaining traffic only on certain days, closing down certain stations, withdrawing either passenger traffic or merchandise traffic, and lastly freight traffic in carloads. In certain cases, however, the passenger traffic will be that which is retained the longest, particularly in surburban areas. Concurrently with these progressive reductions in service, various measures to economize are carried through, such as the reduction of train crews, simplification of rules for train operations, less strict maintenance of the permanent way, locomotives, carriages, and other installations, which are maintained only insofar as is essential for safe transportation. Although this progressive reduction of service primarily aims at cheaper operation, it usually results in a fall not only of expenditure but also of income. Deterioration of railway service will often result in traffic going over to other means of transportation, notably road transport.

As long as a railway line can be operated with relatively low costs for maintenance and renewals and covers its variable (out-of-pocket) cost, the need of closing down may often be not so urgent. At the time, however, when it is necessary to spend maintenance expenses in order to secure sufficient traffic safety or when renewal of its tracks is due, the line will usually be closed down.

8. — Generally permission of the government or a special governmental body is required before a railway can close down any part of its railway system. It is apparently a general rule among railway companies that, before applying to the appropriate governmental authority for permission to close down e. g. a certain branch line which has become unprofitable, whether due to the development of road transport or any other cause, they first make every effort to increase the traffic receipts and reduce the working expenses of the branch line. If these efforts fail to make the branch line pay, and the closing down of the branch is estimated to result in a net financial gain to the system, i. e. the savings in expenditure are estimated to be greater than the losses in receipts of the branch and of the incidental receipts of the remaining parts of the system, the railway administration, after taking into account the transport needs of the area served by the branch line and the possibilities of serving the area by other transport means, may ask the government body to sanction the closing down of the branch line.

If the government regulatory body, for political, military, or other reasons, should decide not to allow the closing down of a

line, even if such closing down indisputably would prove to be profitable, the deficit on operation of the line must usually be covered by the profits on other lines (the « collective risk — equalization » of the lines of the system). This naturally implies that higher rates and fares than would otherwise be necessary must be paid by the users of other parts of the system. With regard to State railways working with a deficit for the whole system, the State, as proprietor of the system, must cover that deficit out of the general revenue from taxes, etc. In some cases, moreover, the State subsidizes transport users in branch line areas or in certain social categories, etc. by compensating the railway companies for losses incurred by having to operate such unprofitable branch lines or having to apply higher operating standards or lower tariffs than are consistent with business economy.

9. — Before the question of closing down light traffic lines and the substitution of road for rail services assumes current interest, railways usually try every possible measure to improve the economic position of such lines. Most of these measures concern reductions in operating expenses, but measures to increase receipts may also be considered.

Operating methods may vary on these light traffic lines according to the nature and extent of the traffic to be carried, and may generally be said to be simpler than on the main lines. The lower traffic volume on these light traffic lines entails a lower transport standard, and means that specialization in train operations cannot be carried through.

The prospects of improving the economy of a light traffic line through special measures on the tariff side are, as a rule, fairly remote. A general increase in tariffs is seldom possible since railways are usually bound to apply uniform tariffs throughout the railway system. In certain cases it should be possible, with flexible selling methods and a differentiated tariff policy with lower rates (agreed charges, quantity rebates, etc.), to provide the impetus for a larger traffic volume, which may improve the economy of the line.

The problem of economical operation of secondary lines of a railway system was subjected to a complete and penetrating study and treatment at the Thirteenth session of the International Railway Congress Association in Paris, 1937.

10. — Railways all over the world have found that road motor traffic in many cases may be an important complement to and substitute for rail service, especially for light traffic on branch lines. In the main, road motor traffic has been used by the railways for the following categories of transport services of passengers and freight :

a) collection and delivery service;

b) interterminal transfer;

c) substitution for line haul rail service on shorter hauls from certain larger stations or centers (railheads);

d) substitution for other line haul rail service.

The experiences of railways show that if they are to provide an efficient over-all transportation service they must have the possibility of using buses and trucks either in a coordinated rail-road service or solely as a road service. Through such coordinated and substitute road services important economic and ancillary advantages can be obtained.

For both passenger and freight traffic most railways are engaged directly or indirectly in road motor operations as feeders or substitutes to rail services through one or more of the following arrangements : wholly owned subsidiaries of the railway, an affiliate of railway, by the railway directly, or by a contractor under railway supervision.

In most countries, if a branch-line is closed down or passenger or freight service withdrawn, the railways cannot establish a substitute road service unless a public concession is granted. If the railway can-

not obtain the concession, for instance because there is already a concessionnaire, it cannot start the substitute service. In some countries, e.g. Eire and Finland, however, railways are authorized to organize a road service replacing rail service.

11. — Modern planning of a new railway line must take into account other possibilities of solving the current transportation problem and the influence of the new construction on the network as a whole. The chief competing alternative to railways in land transportation, namely road motor traffic, — particularly where it concerns transportation in sparsely populated areas and other cases where lighter traffic can be expected — may often afford virtually the same technical transport facilities as railway operation. The cases in which the purely technical and practical advantages of railways compared with road traffic would exclude choice of the latter are in most countries, given the premises in question, probably very few. For nowadays it is usually not a question of establishing new and *longer* routes, but merely of implementing an existing network of communications with relatively short lines. From the standpoint of transport economy alone, the choice of transport facilities designed to meet a new or expected demand of certain magnitude and structure would be determined by what type of facility would, at a given transport standard, be able to execute the transports most cheaply.

However, as in the case of closing down railway facilities, considerations of business economy alone probably are seldom the determining factor in the construction of new railway lines; rather the decision will also be influenced in most countries — especially with state owned or state controlled railways — by considerations of social-economic, social, political, military, or other factors. Such considerations with no bearing upon business economy may sometimes lead to commitments for the railway enterprise through which it will be obliged to execute transport assignments resulting in an economic net loss. So far as the writer is aware there are only a few cases in which a railway enterprise has been recompensed by the State for net losses sustained as a result of such transport assignments not motivated by business economy.

12. — Today it is usually the need of freight transports that necessitates plans for the construction of new railway lines. Since a number of different factors influence the profitability of a railway project, it is usually impossible to lay down any generally valid minimum traffic intensity required if that project is to be profitable. This minimum varies greatly according to the circumstances in each individual case, and as a rule each case must therefore be considered on its own merits. Yet it should be possible, under certain simplified premises, to lay down certain « rules of thumb » as to the minimum traffic density required.

The principal determining factors for the profitability of a new railway line are the probable future volume of traffic at various possible tariff levels and the resultant costs of establishing and operating the traffic, the estimated composition of different commodities carried and the influence of the new line in respect to costs and revenues on the existing railway system.

With a system of tariffs based on the value of commodities carried, the minimum traffic density necessary to attain profitability of a new railway line would therefore have to be greater, if the anticipated traffic consisted of low-value commodities, raw materials, etc., than if it were composed of high-value commodities for which higher tariffs could be applied. Furthermore, if higher tariffs could be applied, at least temporarily, on the new line than on the rest of the railway system, the traffic density required for profitability would be correspondingly lower.

In general the possibility of attaining

profitable operation of a new line may be said to be greater according as increasingly differentiated rates can be applied for passenger and freight traffic using the new line. Hence the general uniformity of tariffs throughout a railway system, which today is very common with railway enterprises, will often render difficult what would otherwise be a practicable expansion and implementation of the railway system with new lines.

When the new railway line is projected to implement an existing railway system, consideration must also be given to the additional and subtractive revenues and costs that will occur on other lines of the system through the establishment of the line in question. Additional revenues may arise through transference to the railways of traffic previously transported by road or by waterway; or because, as a result of the new line, traffic in the latter's area, which previously went by rail to or from stations on the old system, will now use the stations on the new line, which thus implies longer railway transports than before; or, lastly, because the new line may stimulate production and traffic in general. Losses in revenues (subtractive revenues) may arise if the new line leads to a shortening of the transport routes of existing traffic on the railway system; and since the railways usually calculate the freight and passenger charges on the basis of distance tariffs and of the shortest distance geographically between origin and destination, substantial revenue losses may thus be the result in certain cases.

In a similar way and for similar reasons, additional costs and subtractive costs (savings in costs) may occur on other lines of the railway system through the establishment of a new line.

13. — Some railways have made estimates of the probable minimum traffic density under average conditions in their countries that would render a new line profitable. They all stress that such an estimate, by the very nature of the problem, must of necessity be very rough. According to the Finnish State Railways 500 000 ton-kilometres per kilometre of line is, at a rough estimate, the minimum tonnage for profitability of a new railway line. British Railways consider it impossible to lay down any hard and fast rule as to the minimum tonnage required to justify a new line, but on one recently authorised colliery line the anticipated tonnage varied from 500 000 tons a year initially to 1 000 000 tons a year ultimately. American experiences from the nineteen-twenties and 'thirties, indicate a minimum density of 250 000 ton-miles per mile of line.

On the basis of operating and traffic conditions in Sweden it has been estimated that if an isolated local freight traffic line is fully to cover its costs, it will require a minimum traffic density of about 400 000 ton-kilometres per kilometre of line.

14. — In the economically rational planning of a new transport line it does not suffice merely to consider a purely rail or purely road alternative; various combinations of rail-road alternatives must also be investigated. According to the special conditions in each individual instance, it may thus be necessary to investigate rail alternatives, ranging from full passenger and freight traffic to and from a number of stations, to traffic on industrial lines alone under simple forms. For the same reason the road alternative for its part may vary between full passenger and freight traffic on a ramified network, and freight or passenger traffic on a single route. Lastly, various combinations of the aforementioned rail and road alternatives may come into question.

The establishment of a new communication route probably would seldom come into question purely as the result of a greater demand for passenger transport facilities. In general such a demand probably would not be greater at the outset than could be covered by the introduction of relatively small units. Moreover, the bulk of passenger transports in most cases

would probably have a local character and hence would be carried out over relatively short distances. Generally speaking, if the new route consists of railway it will, therefore, not be a question, from the outset, of through trains or cars via the junction to the rest of the railway system, but merely of light rail units confined to the new line. Depending on the trend of population development in the zone which the new route was designed to serve, the situation might of course change by degrees. Yet even a very substantial increase of population in the new traffic zone would not necessarily entail an appreciable increase in the passenger transport facilities required on the new route. If the population should be concentrated, for example, in the immediate neighbourhood of a factory or a source of raw materials, the new means of communication would not have to cope with an excessive amount of traffic.

Hence with regard to *passenger transport* on a new route — if we disregard cases in which major centers of population spring up — the technical requisites for coping with the traffic should in general be about the same for the rail and the road alternative.

But as regards the technical requisites for coping with *freight traffic*, the conditions may assume very different aspects for the two alternatives, due to the nature and quantity of freight, the distribution in time, the distance of transport, etc. Probably a new freight transport route is seldom required for purely local purposes; in most cases the motive lies rather in a desire to link up an unexploited or incompletely exploited zone with other areas and markets, perhaps located at a considerable distance. Even if road traffic facilities nowadays have, from the purely technical point of view in many respects the same possibilities of transporting many types of freight — though more seldom with regard to long-distance bulk freight proper — it will nevertheless be more advantageous from the standpoint of transport economy to employ rail transport over a certain limit, varying with the volume and structure of the traffic and its distribution in time and space, etc.

15. — Construction of new railway lines has risen considerably during the last years, especially in new countries in Africa and Asia. But also in some more industrialized countries in Europe and in America new lines have been built to meet expanding industrial needs and as connecting links and complementary lines to the existing railway systems.

Building of new facilities is nowadays undertaken by railways throughout the world for the purpose of expanding or modernizing their plant, replacing obsolete facilities. Developments in industry, new methods of distribution, and new forms of competition in transportation are bringing new problems in railway operation. Moreover, customers of the railways are demanding higher standards of service than before. All these changes and shifts in the demand for railway transport services, necessitate various adaptation measures in railway operation methods. Such changes in operating methods and facilities have entailed a corresponding need for new facilities and for reconstruction of existing facilities which embraces practically all kinds of fixed property, including revision of alignment, passing sidings, yards, terminals, shops, power plants, locomotive-handling facilities, car-repair and maintenance facilities, etc.

16. — The problem of establishing an efficient transportation system in a region or in a country is not one of choosing between this or that means of transport, but rather of ensuring, through a flexible combination of different transportation means and facilities, the most efficient transportation service under different circumstances at the lowest possible total real cost to the community. The achievement of such an efficient transportation system is complicated by the fact that in most countries the transportation industry consists of a large

number of more or less independent, specialized single-type enterprises, using only one type of transport, rail, road, water, etc., and that governments seldom permit multiple-type transportation enterprises, using all available types of transports, to operate. It is a general experience that the same degree of efficiency and economy of service cannot be obtained through the arrangement of joint service by separate and competing types of transport enterprises. One proposed means of securing an efficient transportation system, which nowadays has many spokesmen, is that the present mode of carriage and transportation by specialized enterprises for rail, road, water, air, etc., should be abandoned and replaced by transportation enterprises with access to and using different available technical transport means (transportation companies).

The development of a transport policy aiming at an efficient transportation system, including among other things coordination of the various types of transport, maximum efficiency in organization and operation of each individual enterprise, will be considerably less difficult in undeveloped areas or countries, where one can start building up the system from the beginning, than in older, more highly developed areas or countries where vested interests in communities, investors, government agencies, etc. try to maintain the status quo.

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